ORGANIZATION OF BRITISH AIR POWER

JULY 1941

AVIATION

The Oldest American Aeronautical Magazine

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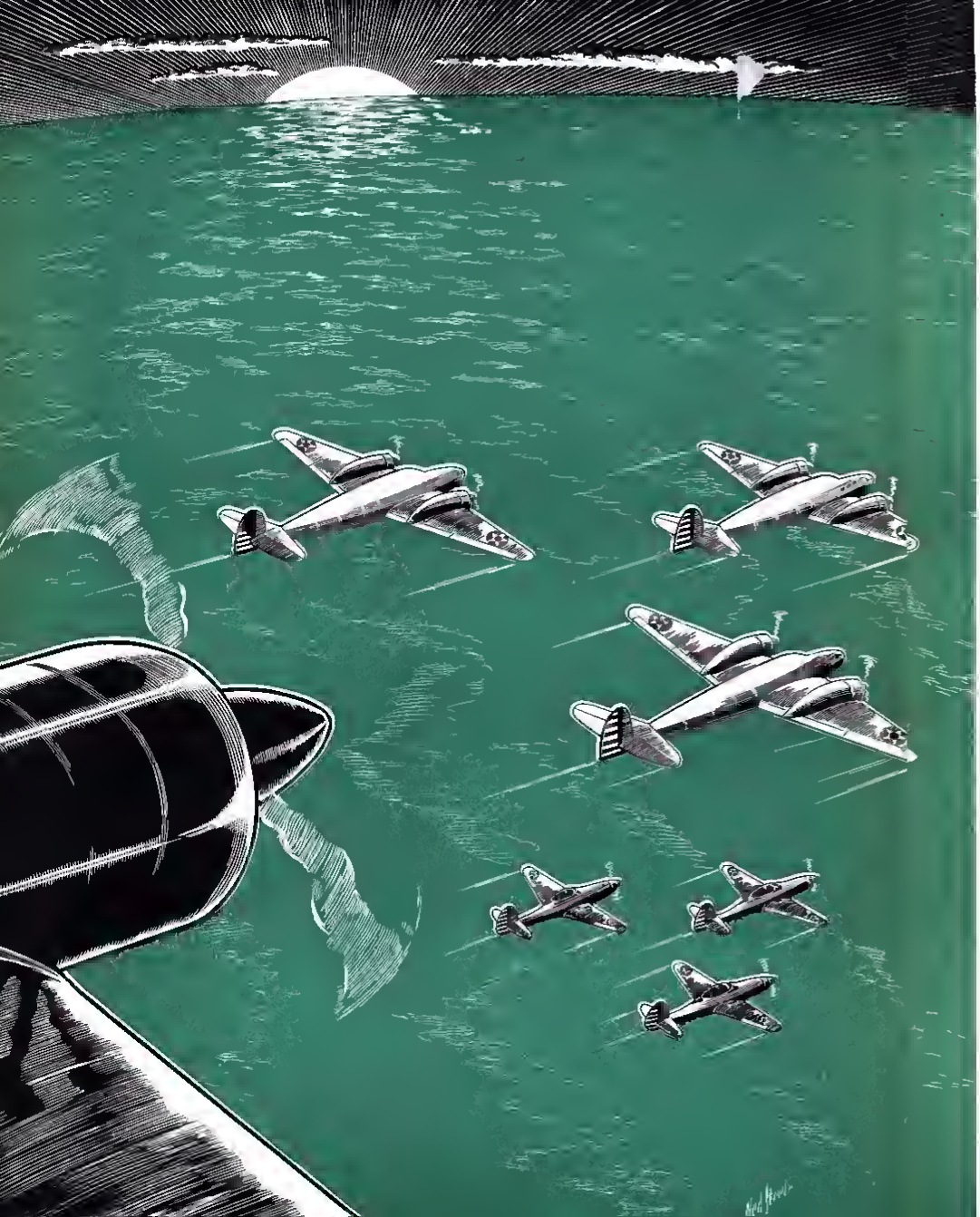

How Houghton helps
"KEEP 'EM FLYING"

IT takes a big ground crew to keep planes aloft; Houghton, which started in business a generation before man dared to fly, is proud today to be part of that ground crew.

All the way from the foundry which makes the cylinder head casting, to the instrument board in the pilot's cabin, this organization plays an essential role. To name a few contributions:

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1865 E·F·H

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Oils & Leathers for the Industries

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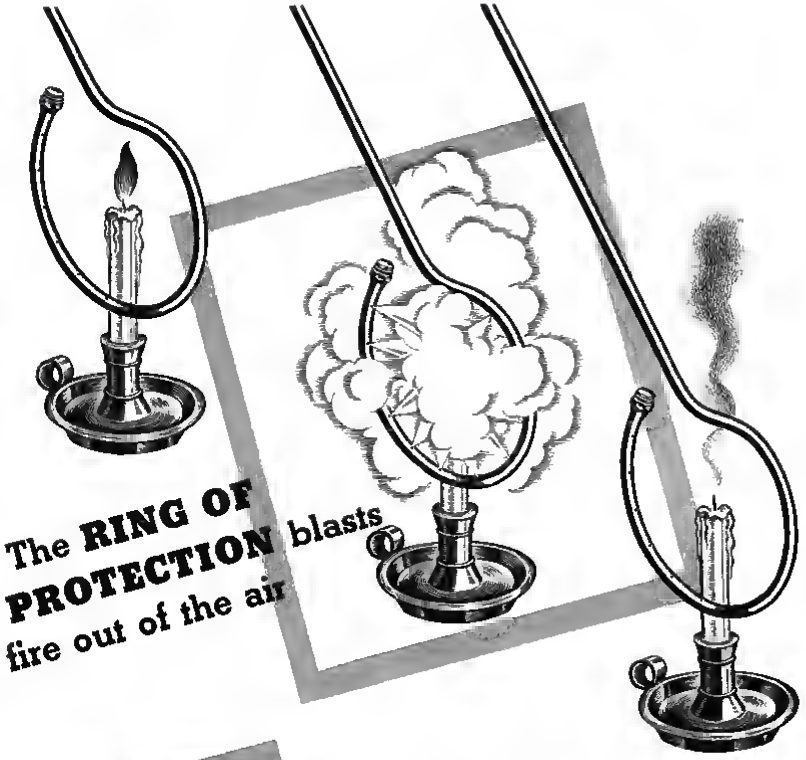
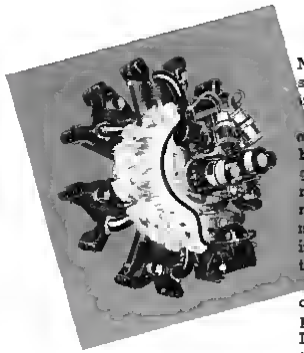


The RING OF PROTECTION blasts fire out of the air



Nowadays it's no more trouble to snuff out an engine fire while flying than it is to shut off the motor.

A slender ring does the trick . . . a ring that suddenly blasts out a burst of carbon dioxide snow-and-gas. It fills the engine compartment with a fire-killing cloud that reaches every tiniest crevice. This is how the LUX Built-in Extinguishing System works. In 3 or 4 seconds the fire's out . . . completely!

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Above Douglas DC-3 standard equipment on most airlines. Below Douglas C-47 U. S. Army cargo carrier. These are basically identical ship ones.

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A NEW ERA OF SKY FREIGHT

Day and night across our nation commercial airlines and the U. S. Army "Transport Wing" are meeting transportation emergencies of the rearmament program. These Douglas-equipped carriers give wings to express shipments, yes, and sky freight which the Air Corps speeds to its depots, aircraft factories and the Panama Canal. Using transports basically identical with standard Douglas models, the Army profits by equipment that was developed for and proven by the commercial airlines. Thus Douglas wings are pioneering a new era of sky freight for a future world at peace.

Douglas Aircraft Co. Inc., Santa Monica, Calif.

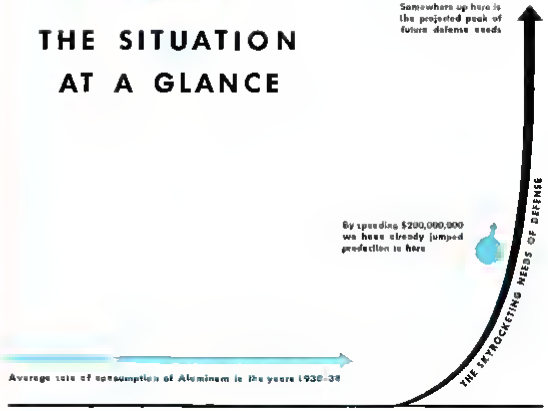
DOUGLAS

FIRST AROUND THE WORLD — *first* — FIRST IN AIR DEFENSE

4

ALUMINUM, DEFENSE, AND YOU

THE SITUATION AT A GLANCE



ONLY TWO OR THREE YEARS AGO, peace-time consumption was down around the level of that horizontal blue line.

NOTWITHSTANDING, even before the tragedy of Dunkerque started Americans thinking in terms of scores of thousands of planes, Alcoa went "all out" with a program which will mean the expenditure of nearly $200,000,000 of its own capital, so as to be ready for unprecedented demand.

THAT IS EXACTLY WHY defense is getting NOW every month, millions of pounds more aluminum than was officially anticipated would be necessary. We produced 50,000,000 pounds last month against an average of 14,000,000 during the peace-time years 1936-38.

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THE SECOND GUESS, like hindsight, is always more intelligent, even when its figures are almost astronomical.

BUT IT WAS THE COURAGE to spend our own money, before there was time for a second guess, that is delivering the aluminum for defense today.

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IN THE BATTLE AGAINST TIME

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"B26" medium Martin Bomber now in mass production.

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Stainless Steel gets rid of dead weight in control surfaces

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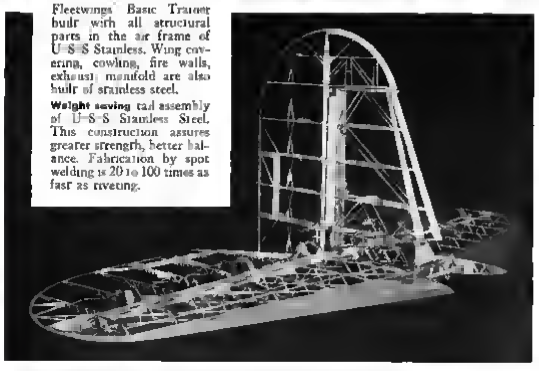
Fleetwings Basic Trainer built with all structural parts in the air frame of U·S·S Stainless. Wing covering, cowling, fire walls, exhaust manifold are also built of stainless steel.

Weight saving tail assembly of U·S·S Stainless Steel. This construction assures greater strength, better balance. Fabrication by spot welding is 20 to 100 times as fast as riveting.



OFTEN overlooked in the design of control surfaces is the fact that stainless steel eliminates or drastically reduces the mass balance required. Weight savings may be anywhere from ⅔ to complete elimination of the dead weight required for balance. On a 5000-lb. plane this reduction through the use of U·S·S Stainless amounted to 45 pounds for the rudder, elevators and ailerons.

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These advantages, plus the structural rigidity of U·S·S Stainless, its ability to take the punishment of control surface use, and its ease of repair make it the "first choice" for severe applications.

Our metallurgical staff will gladly cooperate with you in solving any production problems. Just write

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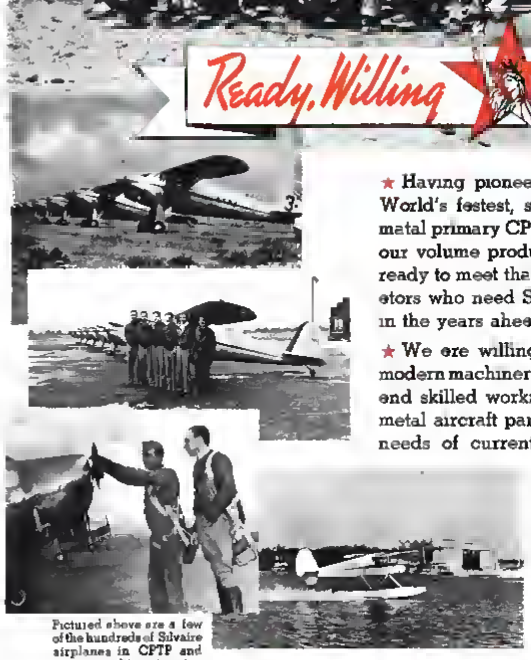
★ We are willing, and able too, to devote our modern machinery, volume production technique and skilled workmanship to the construction of metal aircraft parts and components — the vital needs of current aircraft defense production.

★ For defense training, CPTP operators want and will get famous Silvaire trainers, available with 65 hp. and 75 hp. engines. See your dealer today for full details or write Dept. N



Pictured above are a few of the hundreds of Silvaire airplanes in CPTP and primary military training use both here and abroad.

★ ★ ★

Silvaires are on display at 247 Park Ave., New York City, 350 Maple Street, Perth Amboy, N. J.

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NEWARK, NEW JERSEY

AVIATION

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FLASHES

picked up along the editorial airways

Air Power Scores Again

» SINCE THE SINKING of the "Bismarck" and the Battle of Crete, we haven't heard so much from the older fellows who said airplanes weren't worth much in warfare. The "Bismarck" incident runs up the score for the torpedo plane as a naval type. While it is true that the planes didn't do the actual sinking, they crippled what was probably the most formidable warship in the world and made it possible for pursuing ships to finish the job. It would have been extremely difficult, if not impossible, for British surface craft to perform this mission without the cooperation of the Fleet Air Arm (for details of British Air Power, see page 30.)

» IN THE EASTERN MEDITERRANEAN, at the same time the airplane was proving its effectiveness in an entirely different way. Crete was used as a sort of bloody laboratory to try new methods of insular invasions. This is the most likely explanation of the supreme Nazi effort and diversification of methods used, both of which were out of proportion to the strategic importance of the objective. It is dangerous, however, to compare this action with the problem of the long awaited invasion of England, primarily because of the difference in the strength of defenses and the determination of the defenders. If this really is a rehearsal, for the invasion of the British Isles, as the Germans would have the world believe, it is much more likely that it is practice play for a possible invasion of one of the less strongly defended of the British Isles. In any case it behooves the defenders of Britain to be on the lookout for attack from the direction in which they least expect it.

» WEIGHING THE EVIDENCE AVAILABLE, we must not jump to the conclusion that the airplane alone will solve all military and naval problems. But doubt has long since passed that the aircraft is an absolutely essential ingredient of that delicately balanced compound known as striking power on both land and sea. A squadron of torpedo planes alone would probably all be swamped before they could do any damage to a battleship. But coordinate their activities with the proper proportion of bombers and protecting aircraft with exactly the proper timing, and have the fleet ready to close in after the softening job is done, and you arrive at a result such as we saw in the sinking of the "Bismarck."

The President has sent to the Senate the nomination of Maj. Gen. George H. Brett to the office of Chief of Air Corps, succeeding Maj. Gen. Henry H. Arnold, appointed Brigadier General, and now Deputy Chief of Staff for Air. General Brett has been directing the activities of the Office of Chief of Air Corps under the title of The Assistant to the Chief of Air Corps.

» THE COMPLETE PRACTICABILITY of transporting large numbers of troops by airplane and landing them under enemy fire has been proved at Crete. While dive bombers harassed a ring of protecting warships, soldiers were poured on the objective through a huge aerial funnel until the equilibrium of attackers and defenders changed in favor of the invaders. Reliable observers have said that the parachutists were more successful than the glider-borne troops but that is no reason for us to forget about gliders in warfare. It is not impossible that multiplace engineless ships may be extremely useful in attack on certain types of defenses. We cannot afford to overlook any type of machine that is capable of going up into the air and landing, any more than we can disregard as useless any type of vehicle that can be made to move along the ground.

» WE DEFY YOU TO NAME any type of vehicle which is not used in the remarkable German military machine. In the invasion of the low countries, they used everything on wheels, including bicycles and mule-drawn buckboards, so primitive that they have no brakes and their wheels must be lashed together with ropes while going downhill. True, these operated far behind the front lines but they did their part in preserving communications and consolidating gains. There is a place for everything in the properly balanced military machine.

» ANOTHER TIP FROM THE NAZIS is found in the writings of Col. Hermann Foertsch, of the German General Staff. "Depth of Armament—to manufacture and hold in readiness supplies of every kind, is today the especial responsibility of the military statesman *** A second army of laborers is necessary behind the front *** Here, too the machine, as a weapon of war, exercises a profound effect." All this sounds perfectly obvious and yet we find our military aircraft production beset by labor unrest. As this is written the labor outlook seems brighter, thanks to the prompt action of the President in the North American strike and to the labor leaders who disavowed the minority group which held the upper hand for a short period. By far the greater part of our workers are anxious to do their part in the defense program. There will be honest differences of opinion between workers and management which can and must be settled. But no matter how far apart these opinions may be, there is no earthly reason why the differences cannot be settled without stoppage of work. There must be no slackening in the greatest armament race of all history.

» NEITHER LEGISLATION NOR BAYONETS provide a satisfactory solution to the problem with which we are now faced. The drastic action at Inglewood might have had serious consequences had it not been for the intelligence and tact of Col. Ladd and Lt. Col. Branshaw. The immediate solution is the removal of the few who constitute the disturbing element and who interfere with the sincere intentions of the many to do their part in the defense job. But the only sound solution is to select workers carefully and to teach them to appreciate the part they are playing and the importance of their individual jobs. The project is a part of public relations in their broad sense.

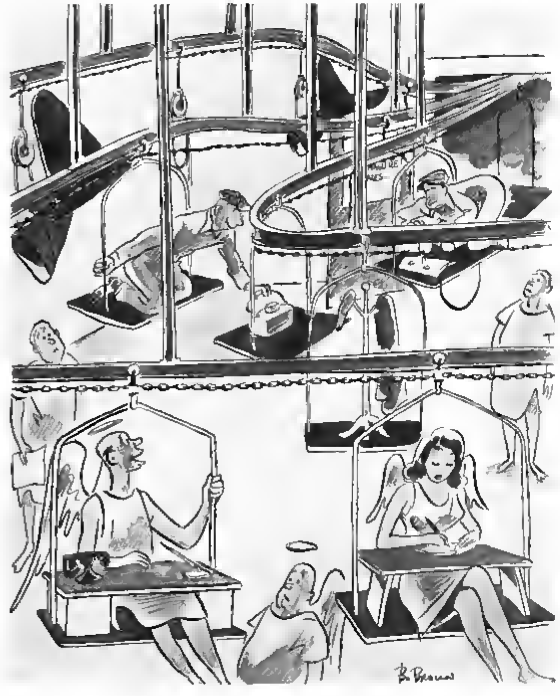
» INDUSTRY HAS GROWN SO FAST that management has lost the "human touch" in employee relations. It is extremely difficult to preserve this close contact when it is no longer possible for the head man to walk through the shop and call each of his workers by his first name. But there are other ways in which workers can be made to feel that they are human beings. And there are some very large organizations in which this is being done, and there labor trouble is licked before it starts. There was a day when the pioneering spirit in aviation tied everyone together, from office boy to president, in a close bond of personal attachment. No matter how big we grow, there will be nothing but grief ahead for those who lose this sense of human values.

» HOLIDAYS, STRIKES, AND SHORTAGES cut into the production score for May which slumped to 1,334 military planes. This compared with a revised figure of 1,389 for April. Although this is more than double last summer's monthly rate, it should have been better. The North American shutdown will play havoc with the total for June, since this company is in the top rank of producers. If sabotage were the motive of this strike, there could not have been a more effective spot at which to inspire a stoppage, since North American has had a large assignment and has been a leader in developing production methods by which to perform its task.

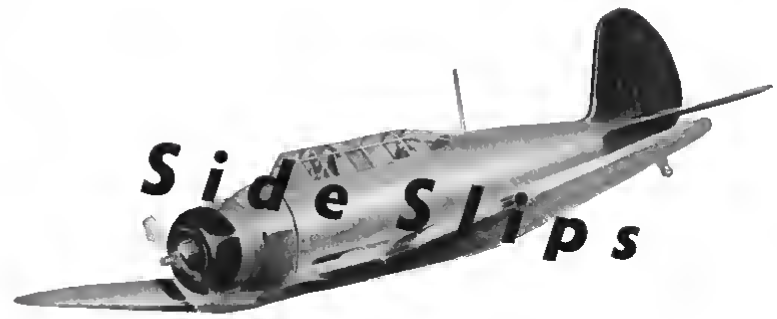
» BUT WE MUST NOT FORGET that a strike in some little plant at Timbuctoo, whose relation to aircraft production may be scarcely discernible, may slow up one or more of the largest aircraft manufacturers. As subcontracting spreads, there will be more and more vulnerable spots where labor trouble may delay production all along the line. Even the smallest subcontractors must handle their employee relations with the greatest of care.

» MILITARY MEN HAVE often been known to be hesitant about committing themselves, but not so with the pair of generals who got together recently on the appraisal of the Civilian Pilot Training Program. Much credit is due the courage of Brig. Gen. Davenport Johnson, new head of Air Corps training activities, and Brig. Gen. Donald Connolly, Administrator of CAA. As a result of their collaboration, General Johnson has testified to the value of the CPTP before Congress, clearing the way for future appropriations and justifying priorities for materials for the manufacturers of CPTP planes. (For details, see page f12)

IT PAYS TO FLY



Maguire has installed a conveyor system to speed production.



» MISS AMERICAN AVIATION FOR 1941 is Miss Carolyn Cassidy, of Louisville Kentucky. It was Birmingham, Ala., that crowned her. Before that she was Miss NAA, and Miss Kentucky Aviation. NAA says that Miss Cassidy "is a sparkling personality, well chosen to typify the aviation spirit of 1941. Much will be heard of her in the months to come," says the Washington Newsletter. Sounds fine, and we are sure that NAA will see to it that we keep on hearing of Miss Cassidy. But we would like to know just *how* this sparkling young lady typifies aviation in this fateful year. Does she typify a 2000 hp gadfly with eight machine guns and three or four 20 and 37 millimeter shell guns spitting destruction? Does she typify a winged monster with a belly-full of torpedoes, whose glass nose holds a man in a cold sweat, riding down a howling dive against a stream of pom-pom fire? Because if she does, we shall be just a little afraid of her. But if she typifies a little plane taking us up high at dusk to see a second sunset, why then we want to hear more about her, and might even be bold enough to ask for the next conga if we got a chance.

» A GRIM EXAMPLE of what can happen to people in the occupied countries of Europe comes out in a letter received the other day by a Dutch friend of ours, from his parents in Holland. The letter says that Albert Plesman, president of Royal Dutch Air Lines, has disappeared and they assume he is in a concentration camp. The reason is, they say, that the Nazis tried to force him to throw the resources of his line into the war, and he refused. This refutes a vicious story that was circulated about Plesman some months ago. According to this story, Plesman, at the time the Germans took Holland, was at one of the Company's airports. On the pretext of showing the field staff a plane that was out on the line, he called them all out of the hangars and buildings. While the staff was thus engaged, the Nazis took possession of the field. When one of the staff men saw what had happened, he whipped out a pistol and shot Plesman dead on the spot. Now, our Dutch friend wants you to know that the story was a malicious invention, that Plesman has stood by his country, and has paid the penalty. Mr. Plesman's first visit to this country was years ago, about 1927. He came to look over our night flying operations, which were just beginning then. He was a big, ruddy-faced, jovial fellow. We personally showed him around San Francisco, never saw a man have so much fun.

» OUR BUREAU OF MISSING PERSONS DEPARTMENT. By the way, whatever did become of those fellows who used to claim that airplanes

couldn't sink battleships? Where, oh, where are the war technicians of yesteryear?

» BEDTIME STORY OF THE MONTH. Once upon a time, in fact it was such a short time ago as 1935, one of the largest aircraft manufacturers used to consider that if he could get three millions in military business per year he could keep his plant operating on an even basis—no profit, no loss. Tough selling it was too, to get that

much business! Considering what one reads in the papers nowadays, children, isn't that very, very funny.

» FOR THE FIRST TIME in a long while the Intrepid Aviator was in the office the other day for a re-fueling from our box of stogies. Said that while he was certainly in favor of the President's 56,000 war-plane program, he didn't think it was a good idea to concentrate so much on four-engined long-range bombers as they would be very impractical for barnstorming after the war.

» POSSIBLY it was just a coincidence, but there might have been some connection between the start of the baseball season and the public's getting thoroughly angry when "Str-r-r-ike three" was called on the vital defense industries.

Above: Vickers Wellington bombers. Below Fairey Swordfish of the fleet air arm.

Photos British Combine

BRITISH AIR POWER

How it is organized and coordinated with land and sea forces

By Major F. A. de V. Robertson, V.D.

AIR power, according to British ideas, must be capable of use in three ways—(*a*) as an independent force, (*b*) in support of the army, and (*c*) in support of the army. This British conception of air power is more advanced than that of most foreign nations, who regard it mainly as an auxiliary for the army. Some nations have also a small naval air arm. Italy is the only other country in which the air force is a separate and independent service. Germany, in particular, trained her *Luftwaffe* to work in conjunction with her army, and when it was doing so it was very successful, but when called upon to undertake a purely aerial campaign it seemed to be at a loss.

The Air and the Sea

Air cooperation with the Royal Navy is provided in two ways, by the Fleet Air Arm and by the Coastal Command of the Royal Air Force. The Fleet Air Arm is a branch of the navy, and is manned by naval officers and ratings. Its aircraft are all carried in warships, some in aircraft carriers and others in capital ships and cruisers. Two main classes of aircraft are taken in carriers, (*a*) fighters, which in some cases can also be used as dive-bombers, and (*b*) torpedo-spotter-reconnaissance machines, known for short as TSR. Because of the limited space in a carrier, each type of machine usually has to be able to perform more than one function, and for that reason among others these ship-planes never have such a good performance as corresponding classes of shore-based aircraft, which are designed for a single purpose.

The machines carried on capital ships and cruisers are always seaplanes, sometimes with twin floats and sometimes small flying boats. They are launched into the air by means of a catapult, and after a flight they have to alight on the water beside their ship. They are then lifted on board by a crane.

A fleet is usually accompanied by one or more carriers, whose fighters protect it from hostile air attack, while its TSR machines scout, spot for the guns, and deliver bombing and torpedo attacks when the enemy ships are out of range of the fleet's guns. When cruisers are on independent missions, as were the *Exeter*, *Ajax*, and *Achilles* in the battle of the River Plate, their own catapult seaplanes scout for them and direct the fire of their guns.

As ship-borne aircraft never have such a good performance as shore-based aircraft, it is far better that the latter should be entrusted with reconnaissance work in the narrow seas and, in fact, all round the British Isles. The body which undertakes this work is the Coastal Command of the Royal Air Force. It is not part of the Royal Navy, but works in the closest collaboration with the Admiralty. Its main duty is to see and report everything that goes on in the seas, but its aircraft are always ready to bomb enemy submarines or other targets, and they will always fight if they encounter enemy aircraft. The Coastal Command uses both flying boats and landplanes. The flying boats are slower, but have a longer range. They fly far out over the Atlantic and to the northern fjords of Norway. For shorter trips, such as to Holland or Southern Norway, the landplanes are usually employed. This command also has some squadrons of three-seater fighters, as there are occasions on which it is necessary for machines to fight their way in to get the information that they want.

The Air Force and the Army

The British Army, unlike the Royal Navy, has no air arm of its own. All its air work is done for it by the RAF. There are, however, certain RAF squadrons allotted for permanent duty with the army, and they are called Army Cooperation Squadrons. They actually work under the orders of the generals who command corps or divisions. Up to 50 percent of the pilots in these squadrons are army officers seconded to the RAF and holding temporary commissions in the air force. While so employed they are addressed by their air force titles of rank and wear air force uniforms.

The duty of these squadrons is tactical reconnaissance, that is to say, examining and usually photographing all dispositions and movements of the enemy up to about 50 miles behind his front lines. They also spot for the artillery, observing the fall of the shells and sending corrections by wireless until the latter have actually hit the target. Very special types of aircraft are used for this work (the present type is the Westland Lysander, a high-wing monoplane) and they are all two-seaters. The pilot, who is always an officer, not only flies the aeroplane but also acts as the observer. He sends wireless messages, takes photographs, makes notes, and studies every movement and change of position which he sees. In the seat behind him is an air gunner. The pilot-observer thus knows that he is protected against a surprise attack from the rear, and so can concentrate on his observations. In these days of clever camouflage it is not easy to read the meaning of what is seen from the air, and the officers need careful training for their work. They are all sent to a School of Army Cooperation before being posted to an A.C. Squadron.

The army needs more than tactical reconnaissance; it needs also strategical reconnaissance far behind the enemy's lines. Certain squadrons of the RAF with machines of longer range than the Lysander are trained to do this work. The army also needs bombers to destroy targets which are beyond the range of its artillery, and it needs fighters to

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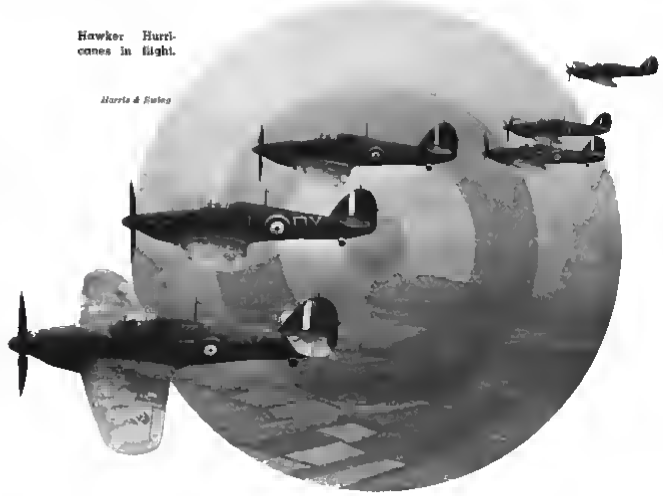
Hawker Hurricanes in flight.

Harris & Ewing



AIR EXPRESS . . . and Where It's Going

In the midst of the current discussions on air express, here are some important figures published for the first time.

By C. Gilbert Peterson,
Chief Engineer, Railway Express Agency, Inc.

Air express shipments speeded by special Railway Express three-wheel motor vehicle from New York to LaGuardia Field are transferred directly from the rear of the truck to magnesium roller conveyor developed by the agency for this operation

WHATEVER form of air transportation emerges in the United States from the present world upheaval—whether air express or air freight or both—Railway Express Agency, Inc., with more than 100 years of transportation experience, fourteen of it pioneering in air express, has a nation-wide organization of 57,000 expressmen completely set up to handle it.

At present the volume of air express is such as generally can be carried on the passenger airliners. Nevertheless, the revenue from this operation which went to the air lines after the direct cost of sales, advertising, insurance and other ground expenses of the Express Agency in the last six months of 1940 averaged $6,395 a day. The air lines fly the shipments. The agency does everything else. It is seldom that the air companies are put to additional flying expense or loss of other revenue because of express.

All air express is flown at rates set by the air lines. These, in general, are high enough to net the air lines more per mile for 200 lb. of express than for carrying a passenger and his baggage weighing the same amount. Examination of the figures reported to the government for various classes of traffic flown on the air lines, including the paid passenger, non-revenue passenger, mail, express, excess baggage and liberal estimate for company material, indicates that the average plane load did not exceed 2,375 lb. per revenue-mile flown for the fiscal year 1940. On most DC-3 flights—standard air transportation—the permissible payload is much higher than 2,375 lb. and even on smaller planes there is usually considerable unused capacity between the actual average load and the permissible load for any given flight.

That unused available capacity on the average passenger airliner is of tremendous importance in the air cargo situation. For example, on the 32 scheduled winter flights daily in one direction from New York to Chicago, 300 lb. additional express on each flight would total 5 tons per day, or a good load for even a large size cargo plane. It is obvious that if more of this empty capacity for air express were used there would be no appreciable increase in flying cost to air lines such as there is when cargo planes are added to regular flying schedules. An extremely high passenger load factor cannot be maintained without inconveniencing passengers, but unused shipments spread between all air lines serving a given route can assist in building up the revenue on that route.

If the cargo traffic moving in one direction during the rush shipping hours of one or two days of the week between certain points exceeds the available cargo capacity on the passenger planes of the various lines, an extra section would quickly clear away this excess and at far less flying cost than one or more permanent cargo schedules being added by the competing lines serving that route. The agreement between the Express Agency and the air lines fully provides for flying freight as well as lighter shipments, and that agreement contemplates various types of cargo service, including expedited, deferred, freight and full plane loads. The Express Agency is as well equipped for handling the latter types as the other types, since it already handles l.c.l. freight for the railroads at 1,033 cities and towns.

There are three major reasons for fluctuations in air cargo traffic. The flow is appreciably greater from east to west and from north to south. There are four well defined peaks in the year—March, June, October and December—with corresponding valleys. A test at LaGuardia Field, New York City, showed that Tuesday, Wednesday and Thursday are the heaviest shipping days. Fortunately the last two peak conditions do not normally fall in peak passenger period, which helps the express situation.

Air express rates set by the air lines in August, 1934 have been in effect ever since, except for a minimum rate rise from 85c. to $1 slightly over two years ago. Rates are based on a formula of 4c. a pound per 100 miles with a maximum of 96c. a pound when the shipment travels more than 2,350 miles. The increase of the minimum in 1938 made no ascertainable difference in the number of low-weight shipments sent, but it did increase their revenue over 17 percent.

Charges for short-haul shipments are relatively low considering the special pick-up and delivery and handling included in air express service. Shipments up to 25 lb. are flown between New York and cities in the radius of Albany, Hartford and Philadelphia for $1; between New York and Boston, Washington and Baltimore from $1 to $2; and between New York and Buffalo, Richmond and Pittsburgh from $1 to $3.

Approximately 15 percent of all shipments are under 350 miles and produce 8.77 percent of the revenue. The accompanying table shows the percentage of shipments and their revenues for all groups of distances for the month of April, 1939.

There is no fixed relationship between air express and rail express rates since they are computed on an entirely different basis. Generally air express rates are several times those of rail express and the spread between the two generally increases with weight and distance. When most people speak of high air express rates they quote transcontinental. Actually the proportion of cross-country busi-

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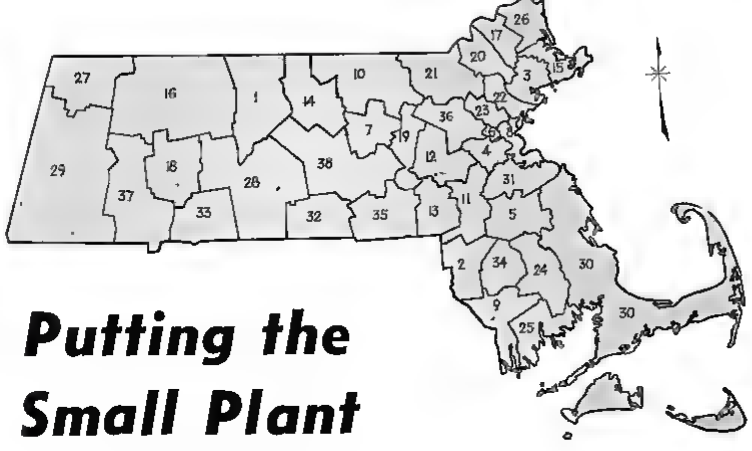
SHIPMENTS AND REVENUE APRIL 1939

Miles	Total Shipments	Percent of Total Shpts.	Percent of Total Revenue
0– 349	10,403	15 78	8.77
350– 649	11,920	18.07	12 50
650– 949	15 944	24 17	20 14
950–1 249	8 301	12.58	12 61
1 250–1 549	3 569	5 42	6 09
1 550–1 849	2,242	3 41	4 36
1 850–2 149	4 033	6 11	8.56
2 150 and over	9,539	14 46	26 97

Below: Packages delivered by motor truck roll down conveyor (right of picture) at airport express office and they are allocated by examiners to individual airline bins. Routing of shipments by various airlines depends upon directness of route, time of departure and speed of service to destination. Lower right: Operator also separate express from airline handlers. After being assorted, stamped and listed, shipments are placed by express handlers in proper bins and then removed on the other side by airline handlers, who load them aboard planes on the field immediately before the take-off. Smaller packages are bagged by express handlers for designated airport cities. The entire system works smoothly and efficiently.



Putting the Small Plant to Work

By Harvey L. Williams

Editors Note: Recognizing the increasing urgency for speed in the delivery of defense products, the hugeness of the defense load confronting industry and the very considerable production facilities that might, but have not yet, been turned to the manufacture of defense items, the editors asked the author of this article to answer the question: "How may a maximum of the country's production capacity be coordinated with the requirements of the defense program and placed in production on defense products? Why do available manufacturing facilities stand idle while the demand for output multiplies? Is there any plan that might put a larger proportion of present machine tools and other production equipment to work now?" The author is recognized as an authority on such matters as "farming out" and subcontracting, having organized the first state-wide production facility survey made in the U. S. to increase the output of military material and having continuously developed methods and procedures for increasing subcontracting during the past two years as an adviser to state associations of manufacturers, state commissions, the National Industrial Council, and a member and first chairman of the Conn. Aeronautical Commission.

"OFFICE of Production Management reports that 50 percent of this country's machine tools either are idle or working less than 8 hr. a day; that some way must be found to put these tools to work . . . OPM suggests that owners of idle machine tools sell them to companies with defense orders."

In such language did a national news magazine describe the condition prevailing less than 90 days ago.

Can these idle and partially idle machine tools be put to work in defense production? Of course, they can. Is concentration of prime contracts in the hands of a small percentage of industrial companies, or an unwillingness by such companies to subcontract, the reason why unused facilities have not been put to work? Decidedly not. There is plenty of work for subcontractors. Work is seeking plants capable of undertaking it. With shortened delivery dates and expanded defense production, a greater demand for subcontractors will exist.

Is excessive cost of subcontracted material a deterrent to subcontracting? In some cases it is. In many it is not. Cost is becoming secondary to speed of delivery. This does not mean "the lid is off" but merely that when a somewhat higher cost is justified by a faster method, of manufacture, the higher cost has been faced analyzed and met in some cases already.

What then is the basic reason why "farming out," "bits and pieces" or subcontracting, has not absorbed idle machine tool capacity? Why are some committees inundated with subcontracts and orders with resultant labor, plant and housing shortages, while others are offering to raise local capital funds for any company that will establish a local industry?

The basic answer is failure to organize an effective country-wide plan. Subsidiary answers are lack of education of manufacturers and of coordination between potential sub and prime contractors. Where good local planning, education and organization of agencies and industry have prevailed, subcontracting is flourishing. Important in such organization is education of manufacturers to what they can do *individually*—to the urgency of their doing their part for their own good, the good of their community and the good of the country. Important is "on-the-ground" coordination between potential subcontractors and prime contractors.

While effective local programs are producing results, no *simple, standardized,* effective program for the whole country has been put in operation, which reaches *down to the doorstep* of every manufacturing plant and machine shop with machines suitable for defense production—which gains and holds the support of state agencies, trade associations, manufacturers' organizations and similar groups by providing a single, definite program in which all may cooperate—which recognizes and uses the valuable constructive progress made in individual communities or states during the last 14 months. No single pattern of organization and field operation has been developed through which the prime contractor's search for subcontracting facilities is shortened to the utmost and through which the prime contractor knows that *one similar procedure* exists in every community to bring him speedy, useful assistance.

Organization of such a plan under high national leadership is practical and possible. Using procedures already tested in use, it can be placed in operation with the cooperation of industry, throughout the country in a short period.

Such a plan was sought by and submitted to War Department officials in January 1941. It recommended decentralized, nation-wide organization to bring defense production to the management of every machine shop and manufacturing plant in the United States, in terms which owners could understand, in a manner which can coordinate the facilities of potential subcontractors and the requirements of prime contractors with minimum effort by both.

Phases of this plan have been tried in the field—partly in Massachusetts, partly in Rhode Island, during the past five months. Desirability of the methods involved have been demonstrated by successful results obtained. In a nation-wide application of these principles, without further delay, lies the answer to spreading defense production rapidly and efficiently—for making use of our present plant facilities as fully as possible.

Such a program recognizes two fundamentals in defense production, considered from the viewpoint of the average manufacturer or shop owner:

(a) *Defense materials are new, unfamiliar products.* That means the average manufacturer knows nothing about them or their component parts. The significance of such a condition is evident if you imagine yourself a dictator with the job of having industry produce $40,000,000,000 of new, unfamiliar articles in minimum time. In that position what would *you* do? Initially you would do just what the War and Navy Departments have done. You would place orders for finished aircraft, tanks, ships, ammunition and ordnance with large concerns capable of organizing the production of complete units on a quantity basis.

Then, what would you do for smaller organizations destined to supply parts, accessories, equipment, etc.? There are said to be some 250,000 such companies and shops. Would you supply each with a list of prime contractors, leaving the rest to the imagination and initiative of the individual management or owner? If you did, you would encounter inertia, delays and disappointments because men do not know the nature of these new products. Some executives would spend the time and money to find out. Many others wouldn't and have not. How much better to discover what each of the 250,000 plants can produce efficiently and coordinate that ability with the requirements of one or more of your prime contractors?

But to do that with so many establishments means wide *decentralization* of effort and leadership. It requires a *standardized procedure* for all parts of the country. It requires a plan that reaches each of these 250,000 plants and provides their managements with a *friendly, intelligent, near-to-home contact* with the defense production effort.

Every machine shop owner and manufacturer cannot be expected to educate himself to the nature of many defense products. The more he attempts to do so, the more time of defense officials and prime contractors' personnel he wastes. If his ability to produce is adequately appraised, if that ability and the needs of a few appropriate prime contractors are integrated effectively, he is provided with the opportunity to make defense products with minimum expenditure of his own and others' time, money and effort.

(b) *Without near-to-home aid or persuasion, many manufacturers will not undertake defense production.* There are still those who want no government business in their plants. They have personal prejudices against dealing with government agencies, having government inspectors in their shops, complying with certain contract stipulations, etc. Yet their capacity is urgently

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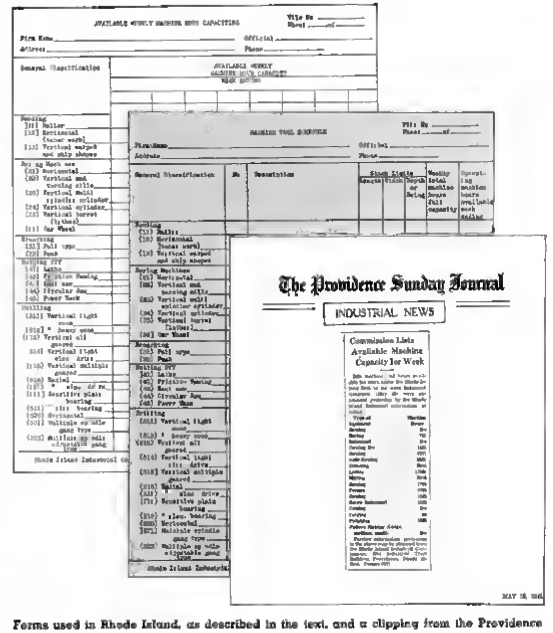
The map of Massachusetts shows the 38 production districts of the state. In these districts are 2,849 plants that are participating in the program described in this article. The following list gives the district number as shown on the map, the principal town and the number of firms in the program.

1 Pittsfield 35 firms; 2 Attleboro 127; 3 Beverley 20; 4 Boston 403; 5 Brockton 38; 6 Cambridge 253; 7 Clinton 18; 8 Everett 63; 9 Fall River 81; 10 Fitchburg 35; 11 Foxboro 9; 12 Framingham 23; 13 Franklin 21. 14 Gardner 19; 15 Gloucester 24; 16 Greenfield 18; 17 Haverhill 18; 18 Holyoke 65; 18 Hudson 5; 20 Lawrence 17. 21 Lowell 18; 22 Lynn 85; 23 Malden 38; 24 Middleboro 28; 25 New Bedford 83; 26 Newburyport 12; 27 North Adams 15; 28 Palmer 27; 29 Pittsfield 13. 30 Plymouth 18; 31 Quincy 31; 32 Southbridge 37; 33 Springfield 39; 34 Taunton 31; 35 Uxbridge 19; 36 Watcham 28; 37 Westfield 18; 38 Worcester 107.



The Providence Sunday Journal

INDUSTRIAL NEWS

Commission Lists Available Machine Capacity for Week

Forms used in Rhode Island, as described in the text, and a clipping from the Providence Journal

Acrobatics Are Easy!

This is Part III of a series on acrobatics which should be of interest to all pilots

By Daniel J. Brimm, Jr.

WE trust that by this time you have recovered from the inverted spin in which you were involved when we left you last month. You will perhaps be glad that you have had experience in this maneuver when you begin practice of the next on the list, which is the half slow roll.

The Half Slow Roll

Conscientious practice of the inverted coordination exercise should have given you a good foundation for this maneuver, which consists of the first half of a slow roll followed by the second half of a loop, and is illustrated in Fig. 1. This may sound very simple, but there are some factors involved which require consideration.

The fact that we are striving for precision in these maneuvers is one of the factors. Almost any kind of a ham pilot can get the ship on its back in some fashion, and haul back on the stick. But to stop the roll when the ship is exactly inverted, and then complete the loop smoothly, requires good timing and familiarity with the upside-down position. Another factor which must not be overlooked is the matter of imposing severe stresses on the airplane. It has been previously pointed out that the speed of the ship increases rapidly in inverted flight unless the nose is kept in the proper position with respect to the horizon. If the speed is high before the half-loop is begun, it will obviously become excessive in the vertical dive which must be accomplished before normal flight is resumed. Pulling out at high speed may pull *off* the wings! On the other hand, if the maneuver is properly performed, the stresses will be little, if any, more severe than those encountered in a good loop.

The half slow roll is performed as follows: with the throttle set at cruising speed, ease back on the stick until the nose is well above the horizon—about the position for a good, steep climb. Assume that the roll is to be made to the right. As the speed drops to 90 m.p.h., apply full right aileron and enough right rudder to maintain direction. This direction may be checked by a mark on the horizon or a cloud, as in the case of the full slow roll, but it is better to go back to the straight road in line with the wind. You will no doubt recall this type of landmark, which was used in executing the loop, Cuban eight, and other maneuvers. The road is more satisfactory than the cloud when performing the half roll for the reason that when you have completed the maneuver you will have changed your direction 180 deg. and can no longer see any object on the horizon which may have been visible when the maneuver was begun—unless, perchance, your neck is made of rubber and you can twist your head around in line with the fin. As the ship rolls past the position of a 45 deg. bank, left rudder must be applied, together with forward pressure on the stick, just as in the full slow roll. In fact, all of the instructions pertaining to the full slow roll are applicable here until the ship is fully inverted, and hence will not be repeated.

As the ship reaches the fully inverted position, the rudder and ailerons are neutralized and the throttle closed, the stick being kept *well* ahead. Hold this inverted position for a few seconds, meanwhile glancing at the airspeed indicator. This should register about 80 m.p.h.; if it shows more, get the stick further ahead until the speed drops to the desired figure. Then quickly, but *smoothly*, pull the stick straight back as far as it will come. As the ship begins to level out after the dive, ease the stick ahead and open the throttle to cruising position, as in the recovery from a normal loop. We hope that you are now lined up with the road and headed in the opposite direction. If not, you did something wrong, let's see if we can determine what.

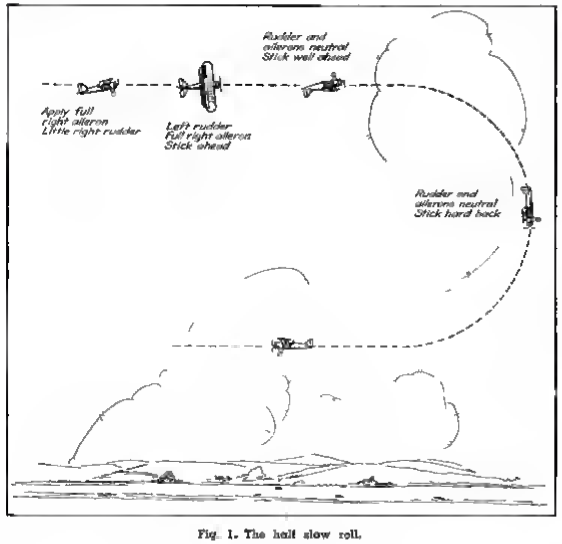


Fig. 1. The half slow roll.

If you are headed to the left of your proper course, you either held left rudder on too long or did not roll quite to the fully inverted position. Conversely, if you are headed to the right of the road you either applied right rudder when you were supposed to have the rudder in neutral, or else you rolled past the inverted position. If your left wing is low as you recover, it is another indication of not rolling far enough; if the right wing is low, you rolled too far.

If you pushed the stick too far ahead while you were upsidedown, let the airspeed drop too low, and in addition left the rudder on too long, you are now probably in a nice inverted spin. Well, we told you you'd be glad you practiced that maneuver and know how to get out of it.

If, on the other hand, you paid no attention to the airspeed indicator, let the nose drop and the speed jump up, you probably felt like you were going to push the bottom out of the seat when you pulled back on the stick. Now here is some information that you should read carefully and *remember*, since it may save you from "blacking out" or even wrecking the ship. If you discover that you have too much speed when inverted, DON'T PULL OUT; ROLL OUT! In other words, simply complete the roll you started. By rolling right-side-up, you eliminate the vertical dive, and return to normal flight without increasing the speed which is already too high. This practice should be followed not only in the half slow roll but at any time you let the speed sneak up on you during inverted practice. The alternative is to push the stick ahead and slow the ship down in this way, but if you do, you'll swear your neck has stretched a foot, not to mention the fact that your feet are likely to fly off the rudder pedals unless you have them pretty well braced. And if they do, you may have some trouble getting them back on again.

By the time you have eliminated any and all of the above-mentioned faults (though if you followed instructions, you shouldn't have developed them) you should be ready for the next maneuver.

The Half Roll and Reverse Roll Out

This maneuver is considered by some instructors to be quite difficult. If, however, you have practiced the maneuvers previously discussed, you will have no difficulty with it at all. It consists simply of a half roll in one direction, a short period of inverted flight, and a half roll in the opposite direction, which brings you back rightside-up again, we hope. No illustration is necessary.

Execute the maneuver as follows: perform the first half of a normal slow roll, bringing ailerons and rudder to neutral as the fully inverted position is reached. Hold the inverted position as long as you wish. Then, assuming that the half roll has been made to the right, move the stick all the way to the left, and apply left rudder. As the ship approaches the vertical bank, ease the forward pressure on the stick so as to

(*Turn to page 170*)

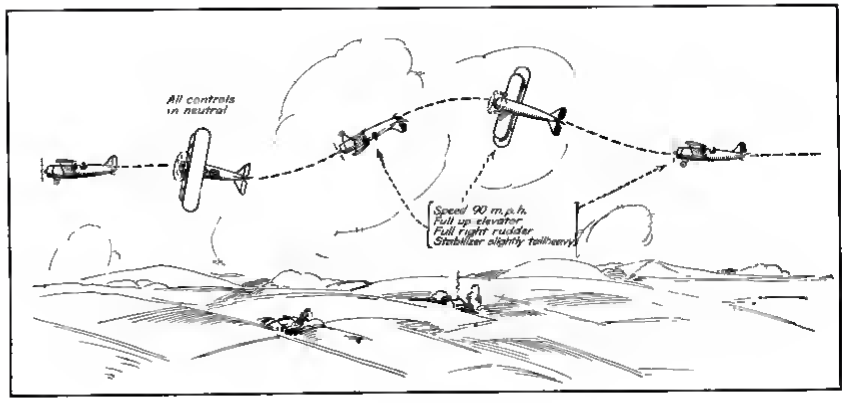


Fig. 2. The snap roll.

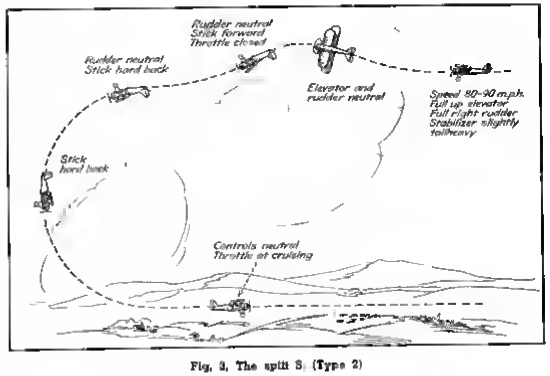
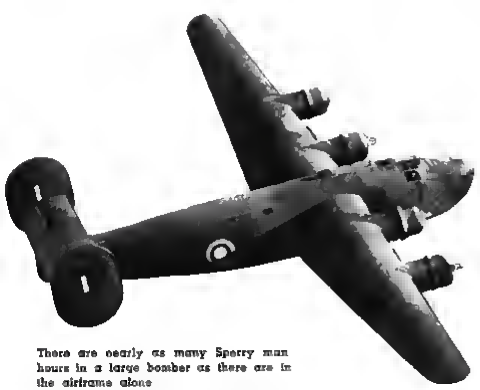


Fig. 3. The split S. (Type 2)



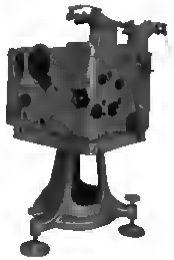
There are nearly as many Sperry man hours in a large bomber as there are in the airframe alone

SPERRY

A LESSON IN INDUSTRIAL PLANNING

By Carl Norcross *Managing Editor, Aviation*

Sperry anti-aircraft fire-control computing mechanism.



Directional gyro instrument for aircraft use.

TOM MORGAN, president of the Sperry Corp, sat in his large office high up in New York's Radio City and talked about national defense.

"The one important question in America today," he said, "is this, what is necessary to increase production?"

Sperry, under Tom Morgan's general direction, is one of the defense firms that knows how to answer that basic but difficult question. The right answers are being found at Sperry because for years its top men have had a deep conviction that the chief asset of any business is its man power. Like other simple truths, this sounds elementary, but it is a fact that has escaped many business organizations.

"If we, as a corporation, are different from other organizations," continued Mr. Morgan, "the difference lies in our fundamental conception of our employees. To us the man on the job is the company. Our strength is in our man power. Every advance we have made, in our products or our methods, has come from a man or a group of men. Therefore we know we must keep our men satisfied if we are to continue our progress. An employee can't do good work if he has a lot of worries. We believe it is our job to relieve him of as many worries as possible concerning his earning and the security of his work. If a man is not producing, either he was not chosen properly for the job or he has not been given a job which allows him sufficiently to use his ability.

"Each of our three companies has a periodic rate review for merit and performance; group life insurance, sickness, accident and surgery benefits, a suggestion plan and other incentives. In short, we have the best organized personnel set-up that we know how to develop."

At Sperry the basic policy concerning relationships between management and men is not something that has been "sold" to an indifferent board of directors by an outside personnel man who wants to create a job for himself. Nor is it a fair-weather policy of a personnel department which the officers of the firm tolerate as long as it is not too expensive. Sperry's conception of man power is part of its long-range attitude toward industrial planning. It is a living part of the entire Sperry Corp. because it has developed from the firm conviction in the minds of Tom Morgan, R. E. Gillmor, Hannibal Ford, Thomas Doe, Harry Vickers and the other leaders of Sperry companies and departments that this is the way to run a business.

Many examples of the working out of this philosophy could be cited. One of the best is the organization of the engineering groups, under chief engineer P. R. Bassett, in the Garden City Laboratories of the Gyroscope Co. The 120 engineers there are a self-governing group, led by a committee of about 20 men. Approximately 100 separate projects are now going on, each headed by a project chief. The unique feature about this organization is the amount of freedom given to even the newest man. There is complete freedom between department heads and between juniors and seniors, without imposing any restraints or requiring that the employee proceed through channels. To make this possible, and yet to reduce confusion, each man must keep his immediate senior informed of matters for which the senior may be held accountable, matters in dispute, and of progress being made. Subject to these simple rules, any man may go directly to any other man to discuss problems.

The result has been a minimum of petty jealousies, departmental politics and prejudices that delay creative work. Freedom of mind and freedom of action, backed by engineering talent, have brought Sperry research to such a practical point that last year two-thirds of the total dollar volume of the corporation was from products that did not even exist ten years ago. Problems that engineers are working on today in Brooklyn, Long Island City, Detroit and Watertown will bring new products for the future.

The Sperry Corp.

Sperry is a familiar name, but few aviation people know the extent of the Sperry Corp. or the number of its products. With the emphasis that has been put on new aircraft and engine plants, on the fighter and bomber programs, and on other phases of the defense program, Sperry's quiet but efficient expansion from employees numbered in the hundreds up to the present total of 15,000 and from the occupancy of a relatively small amount of floor space to that of 14 entire buildings—this has gone unheralded. And expansion to date is just beginning.

Although the 15,000 men and women of the Sperry Corp. compose but a fraction of all those hundreds of thousands engaged in defense work, the work they do and the products they turn out have an importance far beyond that indicated by mere numbers of employees. For the products made by these 15,000 are unique products. No one else manufactures them. They end up in our bombers and battleships, in our anti-aircraft batteries, in our artillery units, as well as in the production equipment in most national defense factories. The name Sperry is indelibly woven in the fabric of defense.

To most of us Sperry means gyroscopes and, as such, the Sperry Gyroscope Co. But this is only one of the three major production units of the corporation. The other two are the Ford Instrument Co., and Vickers, Inc. Actually the corporation has five manufacturing units in all, as the Gyroscope Co. has a subsidiary, Sperry Gyroscope Co., Ltd., which is the British branch and which operates two large factories; and Vickers has a subsidiary in the Waterbury Tool Co. of Waterbury, Conn. British employees of Sperry are not included in the 15,000 figure. These various production divisions combine to form the corporation which is one of the most admirably organized industrial units that can be found.

Each of the three principal units performs a highly specialized engineering and production job, but the engineering talents and the products of one group mesh with those of the other two as precisely and smoothly as the intricately cut gears of a Sperry product. The scope of the corporation's activities are described as the development and manufacture of precision equipment used for navigation on the sea and in the air; for defense against air attack; to increase the efficiency of naval gunnery and military artillery; and the development and manufacture of an extensive line of hydraulic equipment. Even a cursory study of the breadth of this program brings a realization of why the Army and Navy look upon Sperry as an essential defense organization.

As a corporation, Sperry has five general types of activities. In volume of output, the first is anti-aircraft defense. At a time when aerial warfare is the most important kind of military activity, it is logical that a great deal of emphasis be placed on anti-aircraft protection. Sperry is playing an important role in manufacturing equipment to combat air attack.

The second field of activity, in volume, is the production of instruments and equipment for the Army and Navy which the government classifies as confidential.

Its aviation activities, important as they are, rank third in volume in the total Sperry Corp. output. Aviation products include such well-known items as the directional gyro, the gyro horizon, the automatic pilot, and the direction finder.

Hydraulics is the fourth, and least known, field of Sperry activity. Hydraulics itself is little known to the average person except as he has learned of it in connection with the brake-operating mechanism of his automobile. And the names of Vickers, Inc., and the Waterbury Tool Co., the two big names in American hydraulics, are unfamiliar except to engineers and are infrequently associated with that of Sperry. Hydraulics has an industrial future far too important to confine it in a brief sentence. Of this, more later.

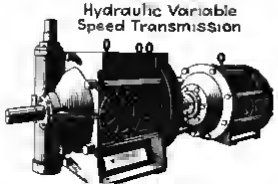
Marine equipment composes the fifth section of Sperry manufacturing. There is scarcely a ship of any size afloat that does not include equipment bearing the Sperry nameplate. There are gyro-pilots, gyro-compasses, searchlights, course indicators and steering indicators, to mention only the most popular marine equipment.

It is an interesting commentary on the Sperry Corp. that while it started with marine equipment as its first products in 1911, the firm has gone on to develop so many new products that marine equipment is now surpassed in volume by the four other divisions. Sperry had a few good products back before the first World War but had it been content to remain in the small field in which it was then engaged it would still be making only gyro-pilots, rudder indicators and compasses for ships' use. Instead it took its good products, modified them for aeronautical use and refined and improved them year by year. Through constant research, its engineers have established many "firsts" with other products. The Gyroscope Co. alone now has over 100 different products, as well as 100 different research projects now actively going on. Just as the heads of the firm saw the possibility of the new field of aviation back in 1913, so they saw the future of hydraulics in 1935 and possibilities of the klystron tube in 1939.

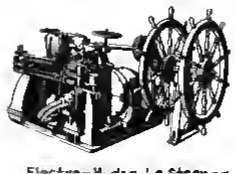
"Each of our three companies is strictly autonomous," Mr. Morgan recently told the writer.

(*Turn to page 166*)

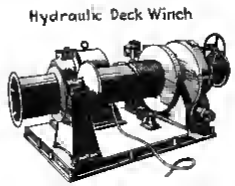
Left, Sperry Ford Instrument and Vickers all make equipment used on battleships.



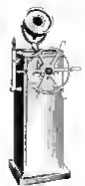
Hydraulic Variable Speed Transmission



Electro-Hydraulic Stabilizer



Hydraulic Deck Winch



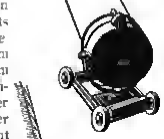
Sperry's Flying Laboratory

Gyro-Horizon

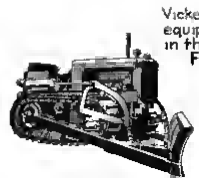
Flightray

Radio Direction Finder

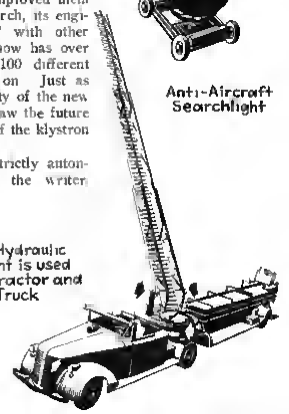
Sound Locator



Anti-Aircraft Searchlight



Vickers Hydraulic equipment is used in this Tractor and Fire Truck



Reducing Stacking Delays

This is what is being done in Chicago and New York to improve the instrument approach of commercial transports. There is still room for greater efficiency.

By C. H. McIntosh, *Instructor in charge, Chicago Pilot Training School, American Airlines, Inc*

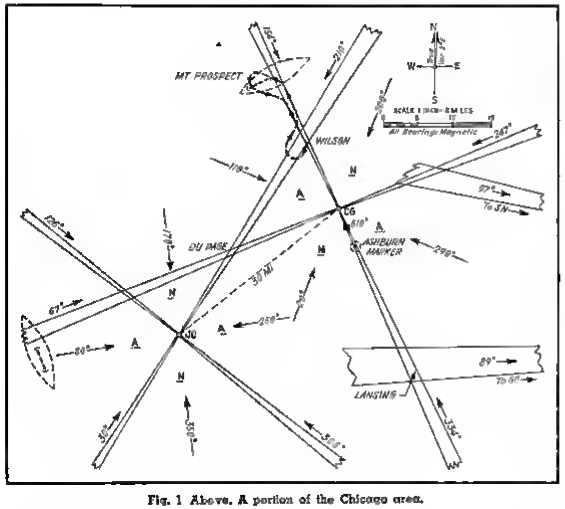
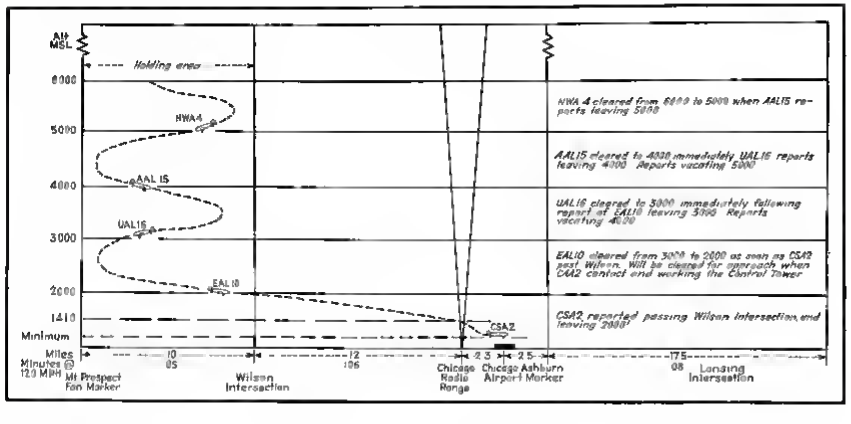


Fig. 1 Above. A portion of the Chicago area.

Fig. 2. Below Let-down procedure at Chicago for flights using the Mt. Prospect Fan Marker and the Wilson Intersection.



FOR a number of years now it has become increasingly apparent to everyone concerned that the Number One weak spot of airline operations is traffic control. This is particularly so during instrument flight weather and in the immediate vicinity of the major terminals.

Long and complicated Airway Traffic Control "holds" with their attendant multiplied stacking of airplanes, spell delay. With the increasing number of airline schedules of the past two years this situation has reached the proportions of a major evil. For delay not only invalidates the major premise of air transportation—the saving of time—but also disrupts smooth airline operation and, in certain types of weather, jeopardizes safety.

This is not to be taken that the operation of the Federal Airway Traffic Control System has failed in its purpose. By correlating the operations of the various airlines, the establishment of uniform flight procedures, and enforcement of time and altitude separation between flights on the airways, chaotic traffic conditions have been averted, and the factor of safety on heavily traveled airways greatly enhanced. The real trouble with existing traffic control procedures is that A.T.C. has been limited to working with methods of control based upon flight and communications procedures which are inherently slow and cumbersome.

Foremost of these are the single track approach systems and the time-consuming let-down procedures which are used at the various terminals during instrument weather. Of course, with existing airport design and radio range navigation facilities it is obviously impractical for more than one airplane at a time to make a landing when weather conditions necessitate use of instrument approach procedures. Only one runway may be used and only one beam of the radio range may be followed to the airport. This situation must for the present be considered a limitation which any system of traffic control must accept. However, the flight technique required by the so-called "standard" instrument approach has long proved a factor of delay that is unnecessary. This part of the problem is readily available for constructive alteration.

Using the standard type procedure, each approach becomes a time-wasting problem. First, a pilot must prove his position over the range station at an initial altitude much too high to allow direct descent to the airport. Thereafter, he must proceed away from the range station and the airport for a time interval of 3 or 4 min. in order to attain a lower altitude from which to start the final approach.

The average time used in all this maneuvering to prove position and lose

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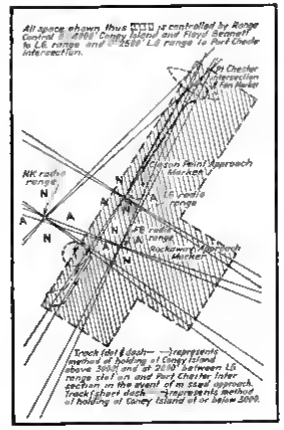


Fig. 3 Range Control area for LaGuardia Field New York City

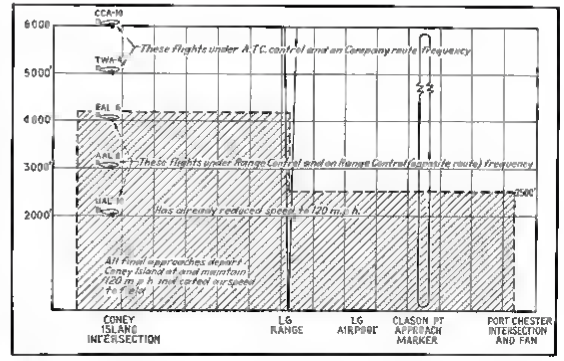


Fig. 4 Above. Operation of LaGuardia Range Control in diagram form. All space cross-hatched is under range control.

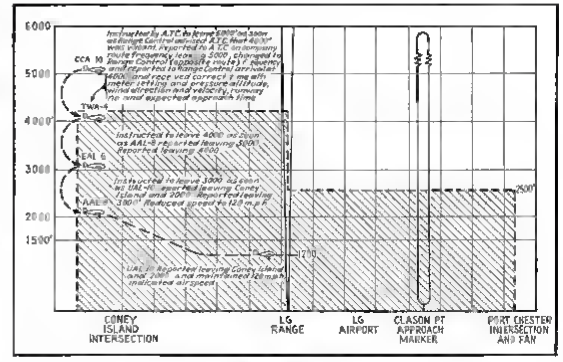


Fig. 5. Above. Four minutes after Fig. 4. Comments on the chart describe the action taken by each flight during 4-min. interval following positions of planes shown in Fig. 4.

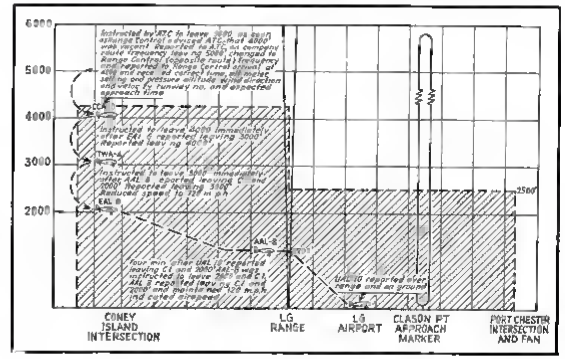


Fig. 6. Four minutes after Fig. 5.

THE DEVELOPMENT OF
Aircraft Spotwelding

Production engineers expect great things from spotwelding. This is an account of what Lockheed has been doing in this new field

By Mabel M. Rockwell, *Production Research Engineer, Lockheed Aircraft Corp.*

THE spotwelding of aircraft materials (mainly aluminum alloys) is fundamentally more difficult than the spotwelding of automotive materials (mainly steels). The reason is that steel has high electrical resistance and low heat conductivity, hence passage of a moderate current will generate sufficient localized heat to make a good spotweld.

Aluminum alloys, on the other hand, have low electrical resistance and high heat conductivity, hence very heavy currents and pressures must be used. Even then, most of the generation of heat occurs at the surface of contact between the sheets being welded.

These conditions have imposed difficulties which have somewhat retarded the application of spotwelding in the aircraft industry. However, of recent years development has come very rapidly. It is the purpose of this paper to describe such development as it has occurred in one aircraft factory.

Left: A 450 KVA Federal combination spot and roll welder with GE controls welding part of a fuselage bulkhead to a floor support

The spotwelding installation at Lockheed originally consisted of one or two small machines on which were welded map cases, scrap-baskets, and other unimportant parts. The real development began 2½ years ago when Lockheed purchased two large spotwelders and began to work on secondary structural parts such as window and door frames.

These welders, which are still doing yeoman service, are rated a nominal 450 kva., but actually impose a 2,000 kva. demand on the power supply when a spot is made in heavy material. They are converted from fixed electrode to roll-spotwelding.

The heavy kva. demand of these welders, plus the requirement that the voltage at their terminals must not drop more than 10 percent when that demand is imposed, necessitated the provision of a very large power supply system. A high-voltage line was built to Lockheed and a substation of large capacity installed. Also, it was necessary to install within the plant, adjacent to the welders, special low-reactance transformers to step-down the voltage from 2,300 to 480 volts. (These incidentally could be eliminated under modern conditions with 2,300-volt spotwelders now available.)

Tribulations were at first encountered in getting these machines into operation, due to the newness and complexity of the control equipment; but these troubles were gradually overcome and a research program was undertaken to establish proper calibrations and settings for the machines and a proper technique in using them. This work will be discussed in more detail in a later section. As a result of the work, the strength and consistency of spotwelded joints were brought to such a high level that the Civil Aeronautics Authority gave Lockheed approval for extending the use of spotwelding to some parts of the primary structure such as skin-stiffener combinations. This gave a great impetus to further spotwelding development and led to considerable increase in the amount of equipment installed.

The Spotwelding Power Supply Problem

The increase in requirements for spotwelding equipment in turn brought to the fore a very serious problem—namely, the magnitude of the power supply necessary for such equipment. The additions to the power supply described in the previous section cost about $70,000 and took care of about six spotwelders. If this were to be multiplied by five or ten, the cost would obviously be excessive, and furthermore, the local electrical utility would be unable to handle such a huge demand on its system.

At this point a saving factor appeared in the form of the "stored energy" type spotwelder first introduced into this country two years ago by a French firm. To understand the advantage offered by this type of machine it should be pointed out that the older machines such as those first installed at Lockheed, are simply single-phase alternating-current transformers which make the spotweld when their secondaries are short-circuited through the material to be welded. They thus impose a very heavy electrical demand for a short period—of the order of 1 to 20 cycles (1/60 to 1/3 second). The "stored energy" spotwelder introduces a new principle—that of charging the transformer up *slowly* with magnetic energy, then discharging it quickly to make the weld. The charging is usually done through a three-phase rectifier.

Front view of a Federal welder being used by Lockheed mechanics to weld a fuselage bulkhead.

The demand on the power line imposed by the slow charging process is much lower than that which would correspond to the quick welding discharge. It is like filling a bucket from a small faucet and then throwing the contents suddenly on a fire.

The stored-energy principle met with so much favor from public utilities and users alike, that American manufacturers took up a similar development. Some of the types now being brought out operate by charging a bank of condensers instead of a magnetic coil. The great need at the present time is for this principle to be extended to roll spotwelders.

Advantages of Roll Spotwelders

The primary advantages of roll spotwelding are *speed* and *consistency*.

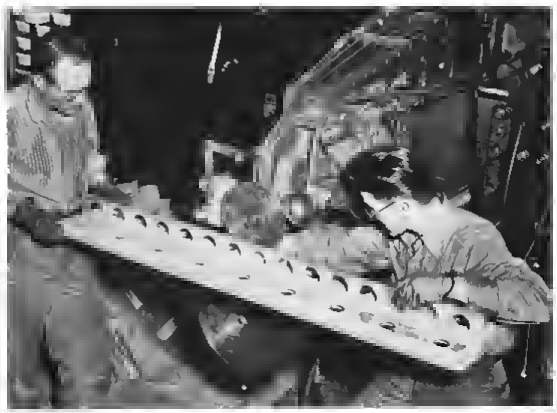
In the roll spotwelder, a pair of large water-cooled copper-alloy wheels is substituted for the fixed electrodes of the ordinary spotwelder. The upper wheel is driven, the lower one idles. The work is fed between the wheels and the automatic electrical control passes current at fixed intervals. Such a machine was at first used only for so-called "seam" welding, where a continuous row of overlapping spots is laid down to make a seam impervious to moisture. Such a process is not very practical for heavy aluminum alloys, however, due to excessive warping caused by the great amount of heat supplied to the seam by the passage of the current. It has been found better to space the spots ½ in. or more apart and so duplicate the effect obtained in ordinary spotwelding, except that the speed is greater. One particular reason for increased speed is that the rolls can be continually dressed down by an idler device and it is not necessary to stop for frequent cleaning of the electrodes, as in the case with the fixed-electrode machines.

The continuous dressing of the rolls also contributes to better weld quality, as the electrodes are always in good condition.

Roll welders now in operation at Lockheed can turn out from 100 to 140 spots per minute. They can average 30,000 spots in an 8-hr shift, if the work is properly designed and scheduled. They are particularly effective on long straight runs such as large skin panels to which numerous stiffeners have to be attached.

Elimination of Welding Troubles

It has been necessary to work along a number of lines in order to bring spotwelding to the smooth-running state in which it now appears to be. The first research was along the line of eliminating "bugs" which interfered with consistent welding. The tendency at first was to blame all these on the complicated electrical control system; but it was gradually found that a great many of the troubles were actually accounted for by deficiencies in two factors—the mechanical system and the cleaning of the surfaces to be welded.



Spotwelding the parts of a frame float rack

Mechanical Troubles

Consistent maintenance of the proper pressure is essential to successful spotwelding, because pressure controls the surface contact resistance. In many machines pneumatic force is used to produce electrode pressure, and if the air lines to the welder are too small the airpressure will drop when the machines are operated rapidly, and mysterious troubles will ensue. It was found necessary to install a large air receiver near the welders to overcome this trouble. Hydraulic pressure systems should be a helpful improvement.

Friction in the moving head of the welder may be the source of very elusive troubles due to erratic pressure. This is more likely to occur in machines having the "press type" or direct-acting cylindrical head, than in the rocker-arm type. The latter are subject to inertia effects, however.

Surface Preparation

Probably the greatest single cause of spotwelding trouble is improper surface preparation. Oil, grease, or paint left on the surfaces to be welded produce cracked, burned, weak, or even "blown" spots. Careful cleaning is essential, and in most cases it is also necessary to remove part of the oxide film which always covers the surface of aluminum alloys.

Theoretically this film should be an

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Electric Arc Welding OF AIRCRAFT STRUCTURES

By Ralph Thorne

Foreman, Tube Structures Department, Vultee Field Div., Vultee Aircraft, Inc.

VULTEE AIRCRAFT is probably the first large aircraft builder to use electric arc welding for volume production of primary fuselage structures. We have now assembled many hundred steel tube fuselages by the electric arc welding method and are currently expanding our rate of production very materially. Time has proved the advantages of the electric arc for aircraft welding and various other plane builders have now adopted it.

This swing to electric welding is not in any sense a criticism of the time-honored technique of gas welding. Both methods produce welds of equal quality. For smooth appearance of the finished weld it is not possible to surpass the gas welding technique. But the electric welding process does possess the advantage of superior speed. We have found that the welding operation can be speeded up approximately 25 percent through electric arc welding.

The reason for this has nothing to do with the quality of the weld or the relative heat at which the metal is fused, but it is due to a combination of several factors. First, the arc is a simple mechanism to handle, in that heat and flux are combined in one instrument, as compared to the separate rod and torch of the gas process. Second, there is no heating up period with the electric arc as there must be with the torch, as soon as the arc is struck, instantaneous welding temperature is produced. Third, the intense heat of the arc allows immediate welding at each particular point along the weld, and constantly if a long weld can be considered as a succession of small individual welds, the arc quickly outstrips the torch which requires, in effect, a heating up period at each small spot. Last, because of the intense immediate temperature in the arc process, the heat is concentrated and confined to a relatively small area with little radiation, whereas with the torch there is considerably more dispersion of heat.

Since a production gain of 25 percent is quite important, especially now in connection with national defense work, it may be asked why electric arc welding was not applied to aircraft production sooner. The answer is a combination of reasons. The technique of electric welding is somewhat more difficult for a man to acquire than that of gas welding. The electric welding control equipment was not until recently of sufficient precision and flexibility to permit the rather precise and delicate work required in welding thin-walled steel tube such as is used for aircraft. It is obvious that a gas flame may be controlled to a wide range of heat and may be adjusted to concentrate or diffuse that heat as required. It has not been so easy to obtain this flexibility of heat control in an electric arc, though equipment now available does meet the problem satisfactorily.

As for training personnel, we have found that this is simply a question of adequate schooling. The technique of electric welding is not unduly difficult for the average man to acquire. We have trained dozens of electric welders at Vultee without any special trouble. Student welders are given a course of training in a local public school under the instruction of competent Vultee men. These classes are offered as a part of the National Defense Training Program. Many of the men taking these courses have been former electric welders on heavier industrial work, and others have been young men who have had preliminary instruction in public schools, or elsewhere. The course is devoted almost entirely to developing manual dexterity on the part of the welder, with such instruction in the theory of electric welding and familiarization with various types of equipment and work as may be necessary. In selecting men to receive this course we give all likely applicants a welding test and from this preliminary bout with the electric arc we usually select about one out of every five applicants. The successful applicants are then put into the school and for the next few weeks they practice welding under close supervision. At the end of that time all the welding students take the standard Army-Navy welding test and an average of about 90 percent of the students pass satisfactorily. The other 10 percent are put back on practice work for an additional week and then again take the test. Very few men fail on this final test. Following their certification as welders these new men are put on small parts subassembly welding work for a trial period. From time to time the men for major welding work are drawn from the small parts welding department. By the above method it will be obvious that every opportunity is given for development of the required skill. No man is given work on welding of primary structures until he has proved his qualifications through the double-check system outlined.

In addition to this pre-employment training program, supplemental trade-extension classes in arc welding are offered to Vultee employees. Many excellent welders, most of whom have had metal fitting or other experience in the steel structures department of Vultee, are developed in these classes.

One other problem which has slowed the adoption of electric arc welding for aircraft work, and which is now being solved satisfactorily, is the supply of suitable welding rod material. Aircraft work is so exacting that the welding rod must not vary appreciably in diameter or composition. Welding rod manufactured to very high standards of precision is now available.

From the standpoint of convenience there is little to choose between in the electric arc and gas equipment. The gas cylinders and the electric welding machines are about equally heavy and bulky, and the electric power wire with its heavy insulation is about as much trouble to handle as the gas supply tubes to the oxy-acetylene torch. The electrode holder is a little lighter than the gas torch, and there is some advantage in obtaining the power supply from the plant electric system, as compared with the shipping and storage problem presented by use of gas cylinders, or the provision of gas generators.

Our welders are P. & H. Hansen machines of 150 amp. capacity vertical type and 200 amp. horizontal type respectively. The rod is a mild steel, heavily coated with a welding flux, and varies in diameter from $\frac{1}{16}$ in., through 5/64, and 3/32 to $\frac{1}{8}$ in., depending on the welding operation. Practically all of our welding work has been on X-4130 steel tubing ranging in diameter from $\frac{1}{2}$ in. to $2\frac{1}{2}$ in. O. D., and varying in gage from .031 to .120. The work done with the electric arc covers about the same field as that usually done with a gas torch. We do a considerable amount of fitting and cluster welding, where steel plates are welded to tubing of varying sizes. A great many steel sheet or steel plate brackets are electric welded to the primary structures for attachment of accessories. One very great problem of electric arc welding has been the cutting of tubes to provide a more precise joint at the point of weld. It is not possible to weld a joint where the gap varies as widely as is standard practice with gas welding. This has required the development of special equipment for profiling tube ends to produce a precision joint. It has been possible to adapt milling

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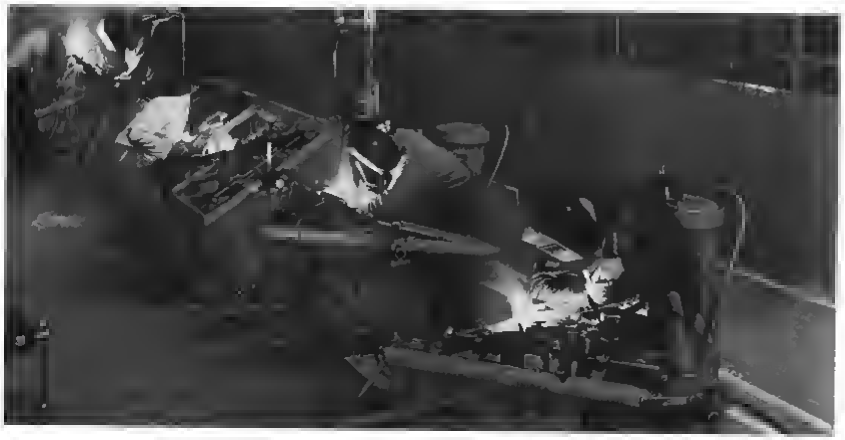
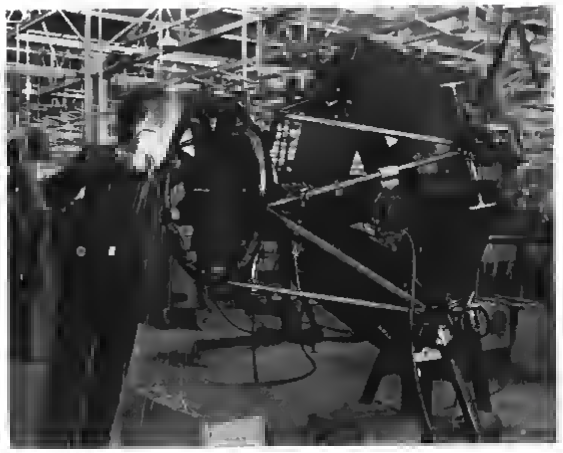


Various subassemblies for trainer fuselages are being welded in these jigs.



A tubular engine mount of a basic trainer being welded. Considerable experience has gone into the design of this sturdy, fast-operating jig.

Subassemblies are brought together in this jig, where a complete side panel for a basic trainer is assembled.

METAL PROCESSING
IN THE AIRCRAFT INDUSTRY

By Ray Sanders

Vice President and General Manager, Turco Products Inc

WITH the many problems that have brought headaches and heartaches to the aircraft manufacturer and operator there has been one consolation. That has been the willingness of the subcontractor and allied manufacturer to help share the problems and to give full cooperation. Calling in the specialist for consultation and suggestions has been more prevalent in aviation than perhaps in any other industry. This logical procedure brings into use added facilities for chemical and engineering research. Today there are many research laboratories maintained by suppliers to aircraft, all working for the good of aviation. The results of this independent research in allied lines of industry have brought into being a tremendous number of materials and methods to answer aviation manufacturing and operating problems.

The development of a complete line of specialized cleaning compounds for aviation has followed the same development pattern as many of the mechanical devices. About 14 years ago we were manufacturing two cleaning materials that had been developed for the aircraft manufacturer and operator. These two products seemed then to be the answer to any cleaning problems. Being located in a major center of aviation activity, Southern California, was a great advantage to us because the aircraft manufacturers and operators brought in cleaning problems that required further research. New products, precisely formulated to each specific cleaning problem, were required. This research and laboratory work was cheerfully undertaken in line with our policy of developing specialized products to meet each cleaning problem, and not just to adapt some existing product to an operation for which it was not accurately suited. Aviation is noted for its wide range and variety of methods and processes. Cleaning compounds are no exception to the variety required. It was soon discovered that the same operation in similar plants might require different cleaning materials. Manufacturing technique, equipment, different metals, heat, operations and facilities brought up new problems and demanded additional research. In a short while the Turco family of cleaning compounds specialized for aviation use numbered 15. By 1936 the number had grown to 25, and today out of the 250 Turco compounds available, 86 have been formulated exclusively for the aviation industry.

Ray Sanders

Why so many? Because these materials must produce not only a chemically clean surface, but also serve in metal processing such as phosphatizing, neutralizing, etching, and other treatments. Also involved is safety of the sensitive metals and alloys, and safety for the workmen using the compounds. Safety factors must be provided both against fire hazards and against health hazards. To meet these factors as they exist in each individual plant requires a wide choice of alternate materials and methods to secure ideal results.

In order to illustrate the wide range of compounds and processes the writer has prepared a chart of the whole aviation field which will serve as a guide to all branches of chemical metal processing in the nature of cleaning, painting, plating etc. The chart on the following page shows all the various processing departments in aircraft manufacturing and maintenance work and the operations and choice of methods and materials to be used in each procedure.

The chart is not intended to be entirely complete, but serves to illustrate the amount of research entailed in a thorough investigation of the object to be cleaned or treated, the safety tolerance of that object, the procedure by which it must be cleaned or treated and, finally, the development of a cleaning material precisely suited to exacting requirements.

As cleaning equipment plays such an important part in the performance of cleaning compounds a separate engineering research laboratory has been installed to devise and develop better cleaning equipment. From this department of the compound manufacturer comes suggestions and ideas on the arrangement or building tanks, automatic continuous spray devices, and suggested improvements on existing equipment that can be built by the aviation customer. Other types of specialized cleaning equipment are developed, manufactured, and sold by the compound manufacturer to fill the need. The Chemical Vapor Cleaner, Hydro-steam Unit, and Flushers are typical of these types.

Many of the better developments in chemical cleaning and metal treatment have come from the interchange of correspondence between the aircraft process engineer or superintendent and the cleaning compound manufacturer's chemists. A recitation of the problem and process involved, to the compound chemist, will usually bring to light a similar instance where that problem has been met. If not, the compound manufacturer should feel morally obligated to undertake the laboratory research work required in a wholehearted effort to solve that problem. In that manner results are obtained, and results are all that count.

The chemical laboratory at Turco where cleaning problems are solved.

AIRCRAFT MANUFACTURE

DEPARTMENT	PROCESS	OPERATION	CLEANING MATERIAL OR METHOD
Metal preparation	Anodizing	Pre-cleaning	Cold emulsion degreasing Vapor degreasing Chemical steam vapor degreasing
		Cleaning	Hot tank cleaning (Foaming or non-foaming, air agitated or still tank) Mechanical parts washer
	Chromatizing (Alloys)	Continuous line production of cleaning, chromatizing and dip or spray priming Stripping Anodic coatings (Method and material) Testing solutions	
	Phosphatizing (Alloys)	Pre-cleaning	Cold emulsion degreasing Vapor degreasing Chemical steam vapor degreasing
		Cleaning	Hot tank cleaning (Foaming or non-foaming air agitated or still tank) Mechanical parts washer
		Continuous line production of cleaning, phosphatizing (dip or spray) and dip or spray priming Turco W O 41 — Phosphatizer Solution testing	
	Magnesium	Pre-cleaning	Removal of mold lubricant hot alkaline solution vapor degreasing Dow treatments
		Preparation for painting	Anodizing
	Stainless Steel	Pre-cleaning	Cold emulsion degreasing Vapor degreasing Hot tank degreasing
		Cleaning	Hot tank — (Alkaline)
		Pickling	Still pickle Electric pickling
Metal plating	Cadmium plating	Heat scale removal	Sand blasting Shot blasting Tumbling Pickling (Turco de-scaler) Electrolytic pickling (Turco Acryl inhibitor)
		Pre-cleaning	Cold emulsion degreasing Vapor degreasing Chemical steam vapor degreasing
		Cleaning	Hot tank cleaning (Foaming or non foaming, air agitated or still tank) Mechanical parts washer
		Pickling	Still pickle (Turco acid inhibitor) Electrolytic pickle (Turco acid inhibitor)
		Passivating dip for chrome and nitric acid, or paint adhesion proprietary dips	
Metal fabricating	Welding (Aluminum)	Testing solutions	Preparation for spot welding (Turco welding jelly) Welding flux removal (Turco Compound #2231) Detecting leaks in tanks (Turco leak detector)
	Heat treatment		Cleaning before heat treatment Cleaning after quench oil Hammer and hydro press parts Steel alloys: Cold emulsion degreasing, Vapor degreasing, Hot tank degreasing
Paint department	Stripping	Cleaning	Cold emulsion degreasing (pre cleaner) Vapor degreasing (pre cleaner) Chemical steam vapor cleaning Hot tank degreasing
		Primer (Zinc chromate)	Hot tank Cold tank Spray (chemical solvent type) Paint remover
		Lionol	Hot tank Spray type Paste type (Turco "S")
		Camouflage (Enamels)	Spray type Brush-on type
		Lacquer and enamel	Spray type Brush-on type
	Department maintenance	Prevention of paint adhesion in spray booths	Turco brush mask Water conditioning Water spray booths Floor treatment to break adhesion
		Department cleaning	Floors, Conveyors, Racks, Equipment: Cold spray or Hot spray or Cold tank or Hot tank
Assembly	Engine cleaning	Removal of protective coating	Turco chemical Steam vapor Cleaner
	Ship cleaning after test flights	Paint cleaning	Camouflage Enamel Lacquer Insignias Waxing and polishing (Turco Min Mum)
		Misc. cleaning	Removal of lubricating oil Nacelle cleaning Propeller cleaning Upholstery and rugs Doped surfaces Metal polishing Metal waxing (Turco Min-Mum)

AIRCRAFT OPERATORS

DEPARTMENT	PROCESS	OPERATION	CLEANING MATERIAL OR METHOD
Engine	Overhaul	Alloys	Cold tank (Emulsion) Warm tank (Emulsion) Hot tank Vapor degreasing
		Steel	Cold tank (Emulsion) Hot tank
		Pistons	Cold tank
		Enamel removal	Dip tank Spray type
		Oil regulators	Emulsion circulatory
		Gasoline tanks	De-gassing, cleaning, leak detecting (Turco Leak Detector) Welding jelly, welding flux removal
		Propellers (Hub and mechanism cleaning)	Cold emulsion Hot tank Vapor degreasing
		Anodizing, chromatizing, phosphatizing, plating	See "Manufacturing" above
Fuselage and Wings	Paint	Cleaning (preparation) Treatment for adhesion (phosphatizing) Stripping	See "Manufacturing" above
		Metal or paint	Emulsion Chemical Saponifiable
	Cleaning	Waxing (Metal, paint — Turco Min Mum doped)	
		Polishing	Turco Red "X"
		De-icers	Turco #400, Turco Plasdit
		Landing gear Lube cutting oil	Emulsion type Chemical type Steam vapor type Cold emulsion
		Removal — wings exhaust stains	Turco Plasdit Turco W O #1
Cabins (Interior)	Cleaning	Paint or metal Carpet cleaning Upholstery cleaning Lavatory Floor Basins Glass Plexiglas	Emulsion type Chemical type Waxing type
	Deodorizing	Lavatory Cabin	Spray type Powder for toilets Spray type

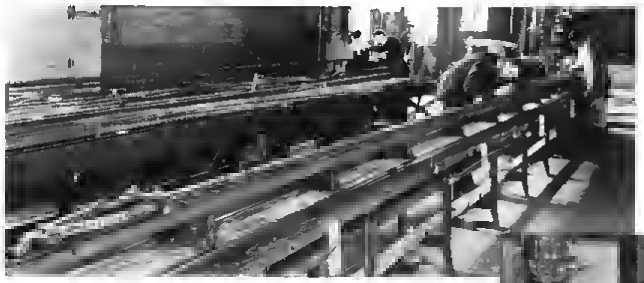
AIRCRAFT MANUFACTURERS AND OPERATORS

DEPARTMENT	PROCESS	OPERATION	CLEANING MATERIAL OR METHOD
Building Maintenance	Floors (Cleaning, bleaching, waxing)	Shop and hangar cement	
		Office	Tile, linoleum, marble, asphalt, painted, waxed
	Washrooms	Hand soap	Liquid Powder
		Wash basins	Liquid Powder Paste
		Showers	Cleaning Bleaching Scale and rust removal
	Walls, woodwork and furniture	Cleaning	Flat finish Satin finish Gloss finish
		Waxing—Polishing	

STAINLESS STEEL FABRICATION

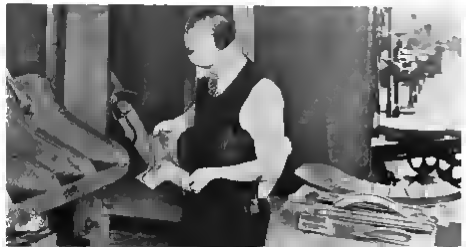
Stainless steel is offering keen competition in quantity production with many of the more generally used materials for aircraft construction. At the Bristol, Pennsylvania plant of Fleetwings, Incorporated, stainless steel structures are being manufactured on this quantity production basis and the following photographs show a cross-section of the methods used. Starting in the stock room (left), the stainless steel arrives in two foot wide rolls, is unpacked and inspected for gage and surface condition

After inspection the rolls are split into the required width (above) preparatory to further fabrication.



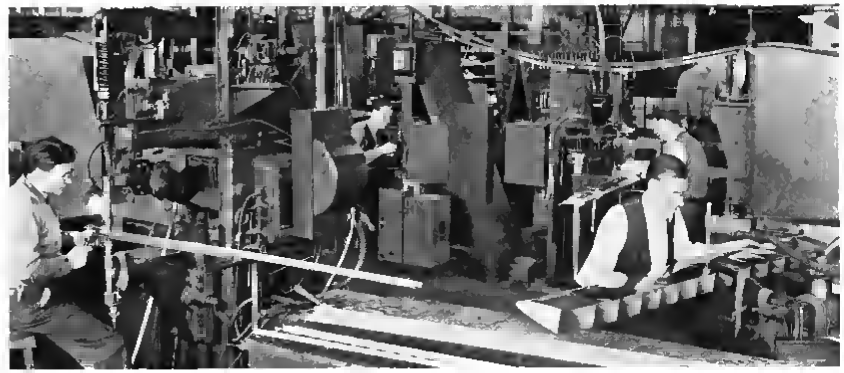
When the strips have been cut on the machine above they are formed into standard structural sections. This is done on the draw bench at the left with the completed sections placed on the table in the center.

Pieces of stainless steel strip that are not formed into sections are stamped out into various shapes (right) on Bliss stamping machines. Other pieces are formed into small parts a few of which are shown below.



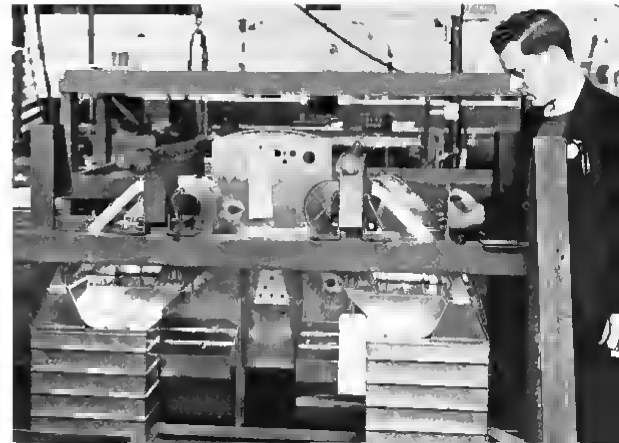
The sub-assembly jigs are mounted on a bench and through the center of the bench run two heavy bus bars to which are attached various welding tongs. These are used in tacking the parts together preparatory to final machine welding. The secondaries of the portable welders are connected to the bus bars, and along the floor are various pedal switches used by the workmen for energizing the weld as required

Some of the sub-assembly parts mounted together in the final assembly jig where they are welded in much the same manner as the operations shown at the left. However, in this particular instance, an air pressure tool is shown instead of the hand welding tongs. The jigs used for this work are of special construction allowing a rapid placing of the various sub-assemblies and easy removal of the assembled part.



When the parts have been partially assembled in the jigs above they are taken to more automatic welding machines where the welding is completed

The finished assembly is then ready for inspection. At the right is shown a completed stainless steel firewall with dummy guns mounted in place with the ammunition boxes and cartridge chutes all mounted into a single assembly



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B-26 bomber tail surfaces, built on subcontract by Goodyear Aircraft Corporation

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Electric Power Aloft

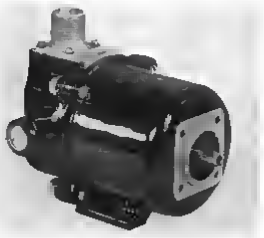
By W. H. Fromm, *The Dumore Company, Racine, Wisconsin*

TWO power systems for the operation of aircraft accessory equipment are in use, electric and hydraulic. Although they are employed on many of the same applications by the industry, they are not strictly competitive, as each has its place. In many instances both systems are used on the same airplane. The purpose of this paper is not to discuss the relative advantages of the two systems, but to describe the performance characteristics and construction of fractional horsepower electric motors and to assist the design engineer in specifying the motor characteristics he needs.

The type of electric motor to be used depends primarily on the power supply. On the majority of today's airplanes a d.c. system with a voltage of 12 or 24 is used, although 120-v. d.c. is used on some large airplanes. Another type of power supply is the high-frequency a.c. system, generally 110 v., 400 cycles, 3 phase. This system, however, has decided advantages only for the largest airplanes.

In electrical aircraft motors the castings are usually of aluminum although magnesium is coming into wider use. The latter metal is not as strong structurally but since it is ⅔ lighter than aluminum it possesses an important advantage, which is only partly offset by the disadvantages of corrosion and care necessary in machining. Aluminum parts are generally anodized for protection against corrosion and magnesium parts are dipped in a pickling bath. Motor housings may be open, enclosed or explosion-proof. The open motor may or may not have a built-in ventilation system, depending upon the duty cycle. Enclosed motors are generally not ventilated, but if ventilation is necessary on a continuous-duty application to keep weight down cooling air may be supplied through pipes connected to the motor housing. Increasing stress is being laid on explosion-proof motors, particularly in military aircraft. On fuel pumps, of course, they are a necessity, but on any application where the motor is mounted in the engine compartment, in the pilot's compartment or near fuel tanks or lines it is probably desirable to use explosion-proof motors.

Electrical connection to motors may be made through several means. Terminal leads may be brought out through the housing to be spliced to conductors of the airplane supply system or terminal studs may be mounted on the outside of the housing. There is an increasing demand, however, for aircraft connectors, particularly in the military field. The Army and Navy have standardized on receptacle and plug dimensions and three or four manufacturers now supply them. These light weight connectors, which are usually of the polarized type, serve the dual purpose of conveniently and positively connecting and disconnecting the motor and completing the radio shielding circuit to ground.



An explosion proof motor for use with an artificer pump.

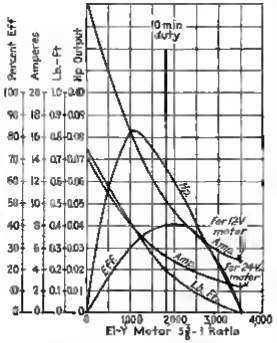
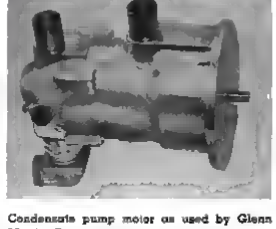


Chart showing the efficiency, amperes, lb.-ft. and horsepower output plotted against the rpm for a small D-C motor.



Condensate pump motor as used by Glenn Martin Co.

Applications for electric motors on aircraft will naturally depend to some extent on the size of the airplane. On light sport planes whatever accessories there are are nearly always manually operated. As the improvements and conveniences on these craft increase through expanding production, however, a substantial new market for small electric motors should be opened. Undoubtedly, the private owner will eventually demand power-operated wing flaps and retractable landing gear. The motor manufacturer will be ready with light, inexpensive motors.

Single-engined commercial or private aircraft having a gross weight of about 2,500 lb represent the smallest ships on which electric motors are generally used today. Wing flaps and retractable landing gear are perhaps the only motorized equipment in this group. Both wing flaps are operated by a single motor with built-in gear box, usually mounted in the fuselage and driving through flexible shafts, chains or torque tube. Landing gear is retracted by means of one geared motor mounted centrally, or two motors mounted in the wings near both wheels. Both motors are small, high-power units designed for intermittent service. Limit switches are employed on both flaps and landing gear to control the motor.

On single-engined military craft, with exception of trainers and reconnaissance airplanes, two additional motor applications may be present because of the high-performance engines used: cowl flaps, for regulating engine temperature, and oil cooler flaps, for regulating

(*Turn to page 150*)

Aviation's Unlimited Emergency

By Selig Altschul

THE subordination of all business activity in the interest of national defense has become an actuality with the proclamation of an unlimited emergency by the President. While virtually complete powers—both active and latent—have previously been available to the President, such control was of little significance as long as vagueness surrounded the defense effort.

Along with the psychological effect of stimulating rearmament activity, the President's statement left little doubt as to what lies ahead. Notice has been served on industry, capital and labor that every other effort will henceforth be subordinate to defense activity. It appears that the government is determined to absolutely control all elements of every phase of our war materials production. The entire economic pattern of the country may be altered in the process.

To the aviation industry—whose very existence has been wrapped up with governmental edicts—this should be no new experience. Along with all industrial enterprises, however, the aviation group may well note certain passages in the President's address. Capital was clearly told that it would not be permitted to make or be allowed to retain excess profits. Here again, aircraft builders have long been limited by statute as to what profit margins may be exacted on government awards.

Of immediate practical significance was the admonition directed at labor leaders to follow recommendations of government mediators in all labor disputes. Active implementing of this policy should remove a serious threat to smooth production in the aviation and other industries. The President also has the power to suspend the provisions of the 8-hr. day law on government contracts.

Private industry itself is far removed from any protective position. The "draft industry" provisions of the Selective Service and Training Act of 1940, empowers the President to enforce compliance of all orders for defense materials. Upon notice from the Secretary of War or the Secretary of the Navy that any individual or firm has interposed any objections whatsoever to such an order or to the price arrived at as fair remuneration by the War or Navy Department, the President may take immediate possession of the needed facilities. In such event, the government may pay only what it regards as just compensation for such facilities by outright acquisition or on a rental basis. No longer will a court determine what is "reasonable" compensation, as was done during the first World War. Moreover, heavy fines and imprisonment sentences await any individual or group refusing to comply with government orders.

The direct action taken by the Army in the North American Aviation case is a clear-cut indication that the period of rhetoric is over insofar as the Government is concerned in settling labor disputes. Defiance by short-sighted labor leaders in the face of Government demands to return to work while the issues are being mediated, was detrimental to the workers involved. *Every major labor dispute settled by Government mediation has been settled by a wage increase.*

While it is difficult to project the duration and scope of operation by the Army, it is likely the plant will be returned to private management before very long. Even under continued Army operation, the equity holders will most likely receive just compensation for their interests. The fact further remains that the Government—directly and indirectly—has a greater interest in the North American plant than the shareholders.

To further tighten control over all civilian activities, the Administration is reported as seeking from Congress, new powers to requisition private property of 'any kind.' These new powers are broad enough to cover privately-owned airplanes, railroads, ships, and a wide variety of other properties used in private enterprise.

It is this "unlimited national emergency" declaration together with the attendant drastic powers available to the government, which may facilitate the redoubling of armament production of every type—with emphasis upon aircraft.

Towards this end—an expanded production program for heavy bombers has been launched by OPM. Primarily intended to attain a monthly goal of 500 big four-motored bombers by the fall of 1942, additional aircraft manufacturing facilities are being pressed into service together with the automotive industry assuming increasing responsibility in the new schedule.

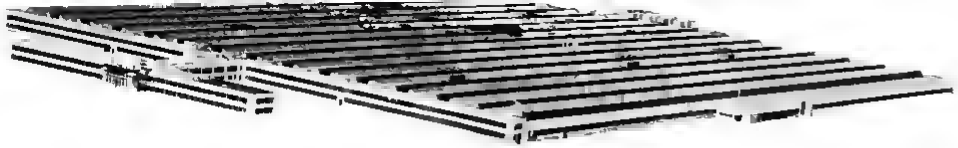
The RFC has set aside 650 million dollars for this new expansion of productive capacity in aircraft, aluminum and magnesium to accommodate the accelerated program. Of this amount, 350 million dollars was allocated for new aircraft plants, 250 million dollars for increasing aluminum supplies, and 50 million dollars to doubling the magnesium program which had been designed to produce about 80 million lb. annually. (The correlation of aircraft production to available aluminum and magnesium supplies will presently be shown.)

All these new plants will be owned by the government and may differ from the previous program under which 2,400 medium-bombers will be built by the prime aircraft manufacturers at mid-west assembly plants with subassemblies supplied by the automotive industry. The new plans, for example, provide for Boeing to start production on heavy bombers at its expanded Stearman division in Wichita, Kan., with Bell Aircraft and Curtiss-Wright assisting as subcontractors. Bell—and to a lesser extent Curtiss-Wright, had long since left the subcontracting stage and have been in the big-time producing completed planes of their own origin. Presumably these two companies and other aircraft units will utilize all available space together with additional facilities for this sub-contracting work. It is conceivable that those companies now concentrating on trainers may contribute their facilities to this new subassembly effort as present contracts are completed.

In addition to other aircraft builders assuming their part in the accelerated bomber program, the Ford Motor Co. has been asked to manufacture and assemble the Consolidated four-engine bomber at its new Ypsilanti, Mich., plant. Previously, Ford had undertaken to supply parts for the Consolidated B-24 to be assembled at the new mid-west plants.

Such is the outline of the greatly increased aircraft production program. It may be a serious mistake, however, to assume that this new expansion will be accomplished at the same rapid rate recently experienced by the industry. A tabulation of a year's arms production since the creation of the NDAC on May 28, 1940, showed the trebling of plane output for this period. Any additional increases in manufacturing facilities and output may prove more difficult as the easiest production adjustments have already been made by

(*Turn to page 148*)



Engines From Line Production

WITHIN the largest single story building in the world, the Wright Aeronautical Corporation is starting to build aircraft engines at one of the largest production rates—one thousand 1700 hp. engines a month. Dedicated only a few weeks ago this huge Lockland, Ohio, near Cincinnati, plant was started less than a year ago on what was then farm land. Literally digging into the problem of building engines against time, the work was speeded along at such a rate that only 142 working days after ground was broken the plant was enough toward completion so that parts were beginning to flow through.

Made up of twelve buildings, counting the test cells and warehouse as one unit, the entire plant covers 2,120,000 square feet of floor space. The main machine shop and assembly building, 1,320 feet long and 1,064 feet wide, stretches out over a floor area of 1,406,756 square feet or 33 acres. Attached to this are 74 test cells arranged in two groups, one for the green test and the other for the final test. Largest other unit in the plant is the aluminum cylinder head foundry, small in comparison to the machine shop, but actually the largest foundry of its type in the world. The architectural style of the main building, featuring a monitor type roof of concrete tile and glass, leaves the floor area completely unobstructed, except where it is broken at one point by a wall to block off the heat treating department. Attached to the front or west, end of the main machine shop building is a T-shaped office building, covering 66,000 square feet. A small building for carburetor test juts out from the northeast corner. East and south of the main building are a water softening plant, an oil and chip storage building alongside the railroad, a boiler house, cooling power for the refrigerator compressor units, a separate building for storing oxygen and acetylene, a master sub-station and a gasoline valve house.

Production Lines

Inside of the plant, the production lines have been arranged so that there are three main aisles stretching across the plant with the individual production lines running parallel and at right angles between them. These production lines run down the 1,320 foot length of the building with the previously mentioned aisles breaking this length into four bays.

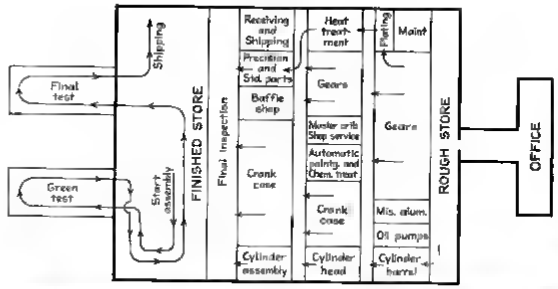
A total of 2,304 tools, mostly of special design, will make up the machine tool lines. Many of these tools have never been used in aircraft engine production before and were designed especially for use in the Cincinnati plant. With the increased demand for engines, the speed necessary for increased production could only be obtained by setting up a line for each part of the engine. Formerly, all the grinders were in one section, all the lathes in another, and all of the drill presses in still another, all according to the machining operation. However, with the application of line production this system was rearranged so that each part is now completed in its own department. For instance, one line of machine tools works exclusively on cylinder barrels. Rough forgings start at one end, pass directly from machine to machine down the length of the line and emerge as finished cylinder barrels. In adjacent lines cylinder heads, gears, cams, supercharger housings, rear covers, nose sections and other parts move down the length of the big floor, each part on its own separate line, headed for the assembly floor and being finished en route.

At present, production is being carried out along "pilot" lines. These pilot lines were set up in the completed section of the factory and work begun on separate parts so that production could begin at the earliest possible moment. Later when new sections of the factory are open, these pilot lines will rapidly emerge into permanent production lines.

When permanent lines have been organized, all of the work will flow from the end of the plant near the office building, where the rough stores department lies down the individual part lines to the assembly bay near the test cells at the rear end of the plant. In this bay a new type of production assembly line has been set up. From this, at an interval of every 24 minutes, a completed Cyclone 14 engine, with its 8,500 parts goes rolling off to the green test cell. To do this, a system was instigated which decentralized the former spot-assembly into a reorganized group of operations which allowed the application of more man power. The previous method utilized eight men which worked as a group on assembly of one engine taking a full eight hour day to complete the job. With the new method 21 stations were set up, each being apportioned an equal number of assembly operations as regards their time for completion. Into this line flow the parts from the plant so that when the engine has passed through the 21 points, it is all assembled and ready for test.

Some of the parts are sub-assembled before being put on the final line. The biggest sub-assembly job of all the line, a section of 500 individual pieces, is completed before the progressive line starts. This is the assembly of the crankcase center section, the crankshaft

One of the new production lines in the new Lockland plant.



to the new cylinder head foundry, largest of its kind in the world, located near the Lockland plant, workmen are pouring molten aluminum from the melting furnace into the pouring ladle.

chip handling will be used throughout the entire plant to speed up the reclaiming of this metal. In the usual manner, the chips will be raked out into a chip bin along side each machine. The bins will be raised by a lift truck, however, since the bins are too large for an operator to handle by himself. These lift trucks haul the chips to big hoppers mounted on trailer trucks lined up outside the plant. Five to eight of these trailer trucks will make up a train, and as each train is filled, it will be hauled off by tractor to the chip handling house.

Crushed to uniform size, the chips are dumped into huge oil separators, machines that work on exactly the same principle as milk separators. As the chips are whirled at high speed, 97 to 98 percent of the cutting oil on the chips is thrown off into drains. The chips, when run through this process, are cleaner than they would be after several washings with soap and water, not even considering the difficulty of washing crushed chips.

Cleaned of oil, the chips are dumped into bins over a railroad siding. So large are these chip storage bins that a gondola car can be filled every eight minutes when a train is being made to haul scrap metal back for re-melt use.

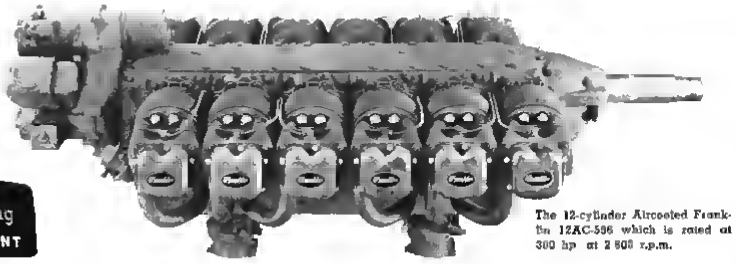
Following the philosophy of the defense program the Wright Aeronautical Corporation has sub-contracted as many parts of the engine as were possible. The Studebaker Automobile Company is going to do some of the work as well as numerous plants located all over the country. Many of the sub-contracted units are to be made completely outside of the Lockland plant, arriving in a condition ready for final assembly after inspection. Several units that are being made in this manner are the crankcases, the connecting rods and rocker arms, and the crankshafts.

This is a new unique Greenlee machine for finishing a section of the supercharging housing.

center section, the two master rods and the twelve articulated rods plus valve actuating mechanisms and timing gears.

When traveling down the assembly line at Station 2, the partly assembled engine comes off the hoist and is placed on a movable stand. At Station 3, the front third of the crankcase is attached and then at successive stations pistons are joined to rods, cylinders are slipped on, the nose section is added the oil sumps, gears, the rear housing and rear covering assembly, carburetor, magnetos, ignition harness, and other small parts are affixed.

An interesting side-light of the machining operations is that automatic



The 12-cylinder Aircooled Franklin 12AC-596 which is rated at 300 hp. at 2,600 r.p.m.

Flying EQUIPMENT

Larger Franklin Engines Developed

New Aircooled 8 and 12-Cylinder Power Plants

By Paul H. Wilkinson

THE name Aircooled Franklin usually is associated with small air-cooled engines with 4 or 6 horizontally-opposed cylinders for small sport planes and trainers. The Aircooled Franklin Corp. has not limited its scope to these two basic types of power plants, however, and now it has developed engines with 8 and 12 horizontally-opposed cylinders. These additional engines will round out the Aircooled Franklin line so that it covers a range from 65 hp. to 350 hp.

The writer first heard of these larger engines from a paper entitled, "Development Problems of Light Aircraft Engines," presented by Carl Doman, Chief Engineer of the Aircooled Franklin Corp., at the Annual Meeting of the Institute of the Aeronautical Sciences last January. Subsequently, he was privileged to see the two new power plants at the factory at Syracuse. Judging from their compact size and low frontal area, it certainly appears that they will be ideal for submerged wing installations in small twin-engined airplanes provided an adequate cooling system is installed to direct the air onto all the cylinders.

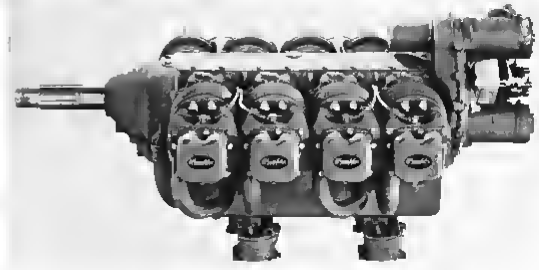
The Aircooled Franklin 8-cylinder 8AC-398 and 12-cylinder 12AC-596 use the same cylinders as the smaller 4AC-199 and 6AC-298 engines. This makes their production relatively simple as many of the other parts of these four basic engines are interchangeable. The bore and stroke of 4.25 in. and 3.50 in. respectively gives the 8AC-398 a displacement of 398 cu. in., and the 12AC-596 a displacement of 596 cu. in. The new engines are not supercharged and they have direct propeller drives. In general construction they are similar to the 4-cylinder and 6-cylinder engines from which they were developed.

Both of these new engines have a compression ratio of 7.0:1 and are intended to operate on 87-octane gasoline. The 8AC-398 model has a take-off rating of 200 hp. at 2,600 r.p.m. and a cruising rating of 170 hp. at 2,350 r.p.m. at sea level. The 12AC-596 model is rated at 300 hp. at 2,600 r.p.m. for take-off and cruises at 255 hp. at 2,350 r.p.m. Geared models giving slightly more power are under development. With supercharging it is anticipated that power outputs of at least 275 hp. and 400 hp. respectively should be obtained from the two engines.

With regard to construction, the crankcases of the new engines follow Aircooled Franklin practice and are made of aluminum alloy in two halves split vertically. A cover plate is provided and there is a detachable oil sump underneath. The crankshaft is machined from a one piece steel forging. It has eight throws and six main bearings in the 8AC-398 engine while in the 12AC-596 engine it has twelve throws and is supported in eight bearings. The main bearings are steel-backed copper-lead faced. The pistons are made of aluminum alloy and are interchangeable for the four basic engines mentioned in this article. They have a steel strut which permits fitting them with 0.003 in. clearance.

The cylinders consist of nickel-iron barrels onto which aluminum alloy heads are screwed and shrunk with a gasket between the two parts. They

(*Turn to page 150*)



The 8-cylinder Aircooled Franklin 8AC-398 which is rated at 200 hp. at 2,600 r.p.m.

FOREIGN FLYING EQUIPMENT

Fulmar Fighter

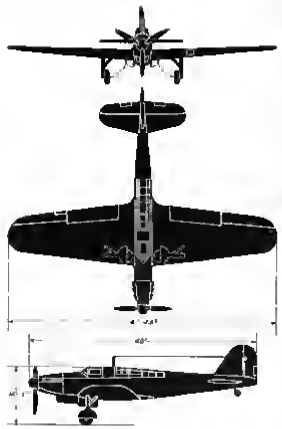
A FAST and formidable eight-gun fighter which has done good work in blasting the muddled Italians out of the Mediterranean air, the Fairey Fulmar is a development from a light bomber type, the P 4/34

Much larger than fighters of the RAF the Fulmar has greater range than any similarly armed land fighter, a characteristic of prime importance in naval operations where frequent landings on a carrier's deck to refuel are a distinct nuisance The "Hurricane" of the Fleet Air Arm, as the Fulmar has been called, is little different in outer appearance from its forebear, the Fairey P 4/34, except that the tunnel-ducted radiator has been moved forward under the nose and the tail plane is set lower on the fuselage in front of the fin and rudder A greater power output is provided in the Fulmar with the 1,145 hp Rolls-Royce "Merlin" X engine as against the 990 hp "Merlin" II in the P 4/34 High speed is probably around 300 m p h with the "Merlin" X, which is a two-speed supercharged type of vee design and low frontal area Propeller is of wood with detachable blades At 5,250 ft the engine develops 1,145 hp (low geared), and at 17,750 ft it has 1,025 hp (high gear) Range is over 1,000 miles

An all-metal low-wing monoplane of stressed skin construction, and equipped with retractable landing gear, armament consists of eight fixed machine guns, four in either wing For use with the Fleet Air Arm it was necessary to arrange for the wings to fold, which was one of the major modifications of the older P 4/34 design Forward part of the fuselage is a bolted and riveted tubular structure covered with removable sheet metal Rear portion is of hoop frames riveted to stringers of Z section and covered with riveted metal skin Wing is an all-metal cantilever two-spar construction, tapering in chord and thickness and attached to stubs integral with the fuselage

Specifications and performance data of the Fairey Fulmar, powered by a 1,145 hp "Merlin" X engine are based on the P 4/34

Wing span	47 ft 4 8 in
Length	40 ft
Height	14 ft 1.2 in
Wing area	346 sq ft
Wing loading	25 1 lb /sq ft
Gross weight	8,688 lb.
Weight empty	6 338 lb
Maximum speed (approx)	300 m p h
Cruising speed (approx.)	250 m.p.h
Range	1,000 miles (over)



Photos Royal Air Force

Carrying eight Browning machine guns four in each wing the two-place Fairey Fulmar has equal offensive powers with the Hurricane and Spitfire

TWIN-ENGINED FIGHTER

An interesting Fokker design which is now under Nazi control

CLOSELY resembling our own Lockheed P-38, the versatile twin-engined, two or three place Fokker G.1 combines remarkable maneuverability and fire power with long range and comparatively high speed. And according to the military use required of it, the G.1 is adaptable to dive bombing and long range reconnaisance, as well as fighter tactics.

Powered by two 880 hp Bristol "Perseus" X engines, its speed is considerably less than that of the P-38. Nevertheless, with a maximum speed of 301 m.p.h., the Fokker G.1 is capable of all the acrobatics a single-engined fighter half its weight can perform. Used as a fighter, and cruising at 227 m.p.h., range is 1,007 miles; or 1,268 miles, cruising at 224 m.p.h., in the dive bomber-reconnaisance version. Service ceiling ranges from 29,200 ft. in the dive bombing type to 30,185 ft. in the fighter. Rate of climb is 1,893 ft./min. and 2,139 ft./min. respectively.

A heavy concentration of fire is provided by eight machine guns, with 500 rounds per gun, installed in the nose of the fuselage. This armament may be altered to other combinations consisting of two automatic cannon, 20 or 23 mm., with 60 or 100 explosive shells, and two machine guns with 450 rounds each; or four 20 mm. cannon with 60 shells per gun. Rear defense is relatively weak, the rear cockpit being provided with only a single machine gun, as in the Messerschmitt Me 110. Bomb racks are reported to carry a total of 882 lb. of bombs.

The fuselage is built in three sections, the front section being a welded steel tube structure covered with aluminum alloy sheets. The center is of plywood, monocoque construction, which forms an integral part of the wing, while the rear section is a light metal framework having large transparent plastic windows. Good vision is afforded the pilot whose cockpit is situated forward of the leading edge of the wing. In the three-seater type, the central cockpit has windows above and below, while the rear cockpit has a visual range above, to the sides and rear, and openings in the floor for bomb sight or camera.

Wings are of wooden construction, with two box spars having spruce flanges and bakelite plywood webs, bakelite plywood ribs and covering of the same material. Dural landing flaps, hydraulically operated, are between ailerons and tail booms and between tail booms and fuselage. Ailerons are fabric covered, welded steel tube construction.

Tail booms are monocoque type with dural frames and duralplat skin, while the horizontal stabilizer and fins are all-metal construction consisting of dural spars and ribs with duraplat sheet covering. Balanced rudders and elevators are fabric covered, welded steel tube structures.

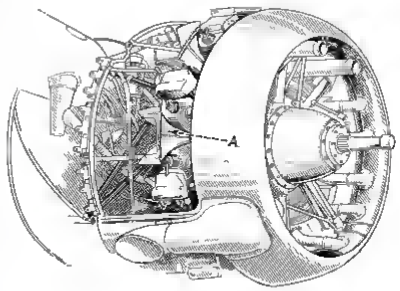
Landing gear, which is hydraulically operated and fully retractable, is equipped with oleo pneumatic shock absorbers and pneumatic wheel brakes. The tail wheel is a swivel type and may be locked.

Standard equipment includes three-blade variable-pitch or constant-pitch propellers, complete electrical lighting system, including two leading edge landing lights, radio, provision for a camera, and oxygen apparatus.

Instruments are Weston tachometer, cylinder head temperature gage, Kollsman boost indicators, fuel and fuel pressure gages, oil manometers and temperature gages, altimeters, Eclipse synchroscope, air speed and rate of climb indicators, Waltham clock, Sperry gyrorector, turn-and-bank indicator, and Askania compass.

Specifications and performance data on the Bristol "Perseus" powered Fokker G.1 fighter type are:

Wing Span	56.122 ft
Overall length	35 913 ft.
Overall height	11 186 ft.
Wing area	412.26 sq ft.
Power loading	5.94 lb./hp.
Wing loading	25.7 lb./sq ft.
Gross weight	10,560 lb
Weight empty	7,546 lb.
Fuel capacity	370 gal
Maximum speed	301 mi.
Cruising speed	227 mi
Service ceiling	30,185 ft.
Rate of climb	2,139 ft./min.
Cruising range	1,007 mi

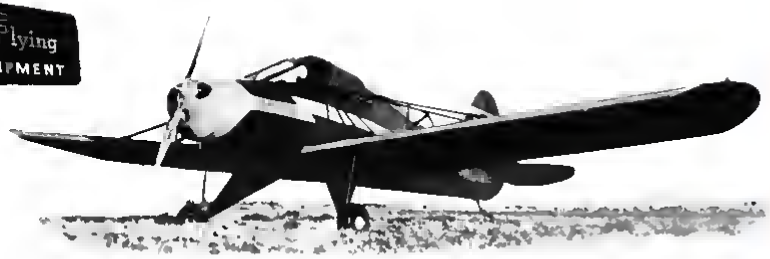


With the cowling of the Fokker G.1 removed the unique cooling baffles between the cylinders can be seen (A). The exhaust collector ring runs forward around the periphery of the inside of the cowl with the exhaust stack shown on the side.

Schostal Agency

The Fokker G.1 fighter may be used in dive bombing operations.

Flying EQUIPMENT



CallAir Model A

A two-place cabin plane from Star Valley, Wyo.

QUICK take off, fast climb and slow easy landing performances are characteristics of Call Aircraft Co's two-place, 80 hp cabin plane. A low wing monoplane, it is the result of three years of comprehensive engineering and investigation in the high altitudes of Afton, Wyo., where Call Aircraft is operating in its modern 7,000 sq.ft. building in Star Valley.

In developing the CallAir a great deal of experimental flying was done from the company's field, 6,200 ft. above sea level. Pilots flying the plane have found a fine balance of the controls and a quick response to every maneuver. Because of the low wing, visibility is very good and, in addition, the low position of the engine gives a complete panoramic view directly over the nose of the ship even with the tail down.

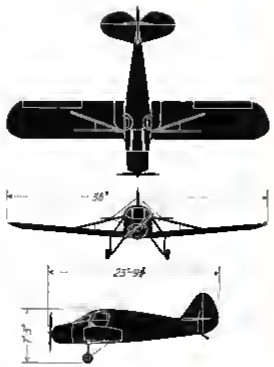
With its cruising speed of 100 m.p.h. and a range of 500 miles, the plane operates at the economical rate of 20 miles to the gallon of gasoline, using a Continental engine. A low landing speed of 40 m.p.h. makes it adaptable to small fields. Maximum speed is 106 m.p.h. and the service ceiling is above 13,000 feet.

Fuselage and tail group are of chrome molybdenum steel tube construction, while the strut-braced wings are of solid reinforced spruce spars and built up spruce ribs with dural leading edge and continuous drag bracing. An 8 ft. landing gear tread, providing stability on the ground, is equipped with spring type shock absorption and Hayes hydraulic brakes. Tail wheel is full swivelling type.

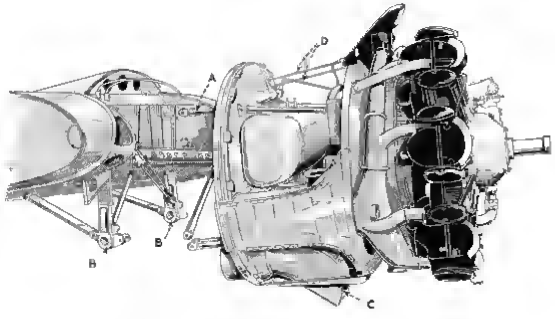
Equipment includes standard instruments, Freedman-Barnhart propeller, Goodrich tires, parking brake, Grimes navigation lights, Arens controls, Pyralin windshield and cabin enclosure, radio shielding and antenna, fuel gage and tab position indicator, and landing flap for glide control and sleep approaches.

Specifications and performance data of the CallAir airplane, powered by a Continental 80 hp. engine are:

Wing span	36 ft.
Length	23 ft. 9½ in.
Height	7 ft. 3 in.
Wing area	181.6 sq.ft.
Gross weight	1,450 lb.
Weight empty	885 lb.
Useful load	565 lb.
Baggage allowance	65 lb.
Wing loading	7.98 lb./sq.ft.
Power loading	18.13 lb./hp.
Maximum speed	106 m.p.h.
Cruising speed	101 m.p.h.
Landing speed	40 m.p.h.
Service ceiling	13,000 ft.
Cruising range	500 mi.

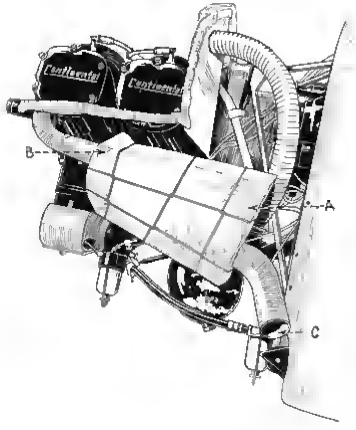


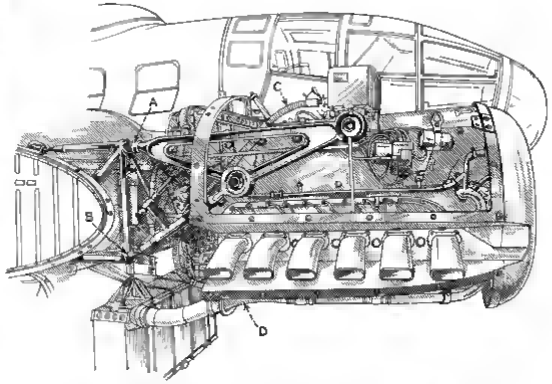
AVIATION SKETCH BOOK OF DESIGN DETAIL



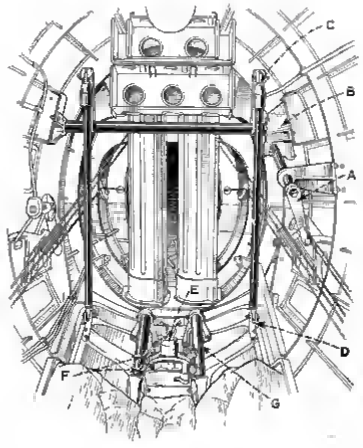
The engine mount shown (left) is for an early model Lockheed 14. The engine mount "A" is made of 1¼ X 058 in. steel tubing and is designed to support a power plant weight of 1838 lb. subject to a maneuvering load factor of 5. The attachments 'B' are of the sheer pin type made of forged steel fittings. The scoop "C" is for the oil radiator and is retractable being controlled from the cockpit. The controls of "D" are for the carburetor and propeller.

The new Luscombe (below) utilizes a rather unique exhaust manifold system. The exhaust enters the manifold at "B" and leaves at "C". "A" is an asbestos covering.

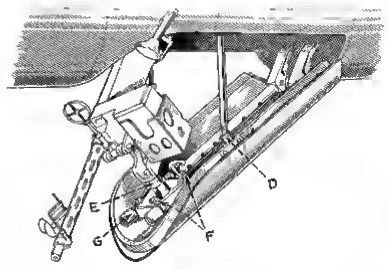




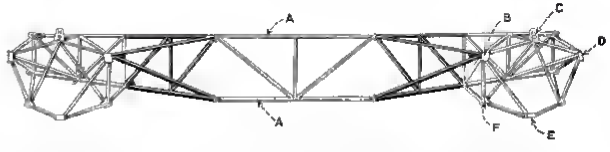
Above is the engine installation in the Heinkel He 111. The forged magnesium engine mount is attached by an easily removable lifting at "A" with a similar mount at "B". The oil radiator located at the top of the engine has its return pipe to the engine run down at "C". The liquid cooling pipe connecting the radiator below the engine in the cylinder heads is shown at "D".



The Northrop N-3 Patrol Bomber has as part of its armament a flexible .30 caliber machine gun firing through a trap door (above) in the bottom of the fuselage. This gun is mounted on the pinion of "E". "A" is a hand crank for lowering the trap door which is accomplished through the gear box at "B", forcing the arms "C" downward. The trap door is then forced open at 'D". The gun can be moved fore and aft along this trap door by use of the rollers "F" on the tracks "G". Around the door opening 24 S. T. stressed skin fuselage covering is reinforced by heavy channel sections.

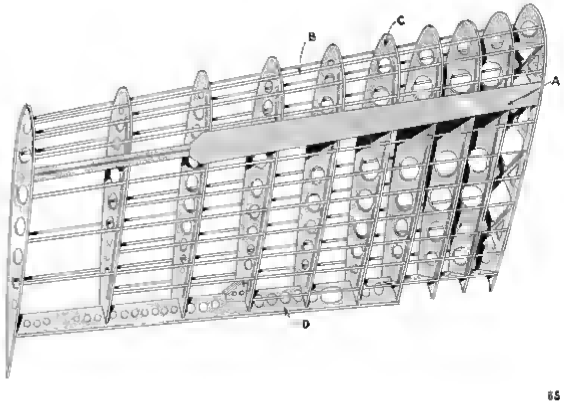


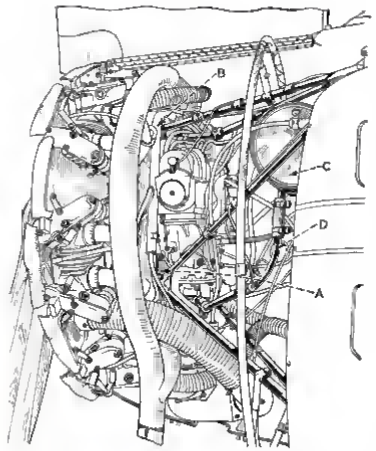
The exterior view of the .30 caliber trap door flexible machine gun installation of the Northrop N-3 PB, is shown above. The lowering and raising mechanism is shown attached at "D" as in the interior drawing. Likewise the gun is shown mounted on the carriage of "E" with the rollers "F" on the track "G" for controlling its position.



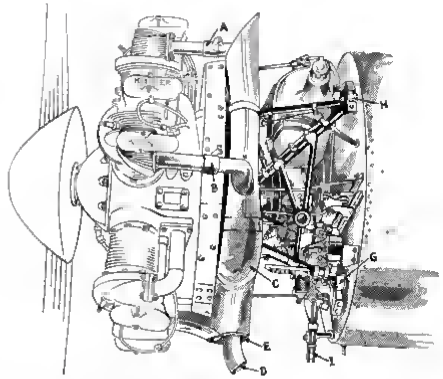
The steel center section truss (above) is used on the Beechcraft Model 18S. On the mounts on either end the engine is attached. The main longrons "A" are made of elliptical X4130 steel tubing. Points 'B' "D" and "E" are for the engine mount attachment. Maximum loads for which they have been designed are "B"—6 149 lb., "D"—6,307 lb., and "E"—11 613 lb. Point "F" and the corresponding point on the other side are attachment points for the top of the shock absorber. The loads to them are as follows: 12,973 lb. and 16 575 lb. respectively. Point "C" is not considered as an attachment point for the engine.

At the right is a drawing of an uncovered wing of the Beechcraft 18S. The maximum load on the main wing beam "A" exists at the root section and is approximately 70 000 lb. The stringers "S" are ½ by ⅜ inch 24ST bulb angles .050 inches thick. The spacing on stringers is approximately 7 in. 8 inches at the root rib tapering to 3½ to 4½ inches at the tip. The thickness of the root rib is .032 and on the next five ribs out are .025 and the last four ribs are .020. The aileron attachment 'D' extends over 71% of the span of the outer wing panel. Detachable wing tips are provided. The bending loads from these wing tips are transferred directly into the skin of the outer panel by means of bolts in sheer. The vertical shear is transferred to the shear web of the outer panel spar through a piano hinge.

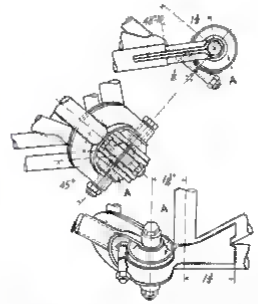




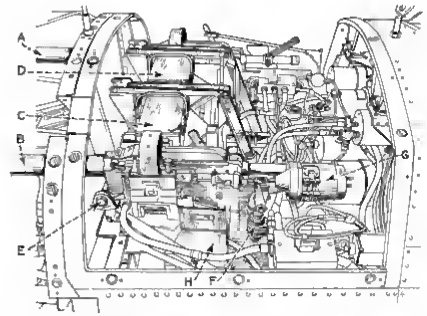
The engine installation of the Kee Royce engine Model 7 G installed in the Rearwin Cloudster Model 8135 is shown above. This engine is rated 120 h.p. at 2225 r.p.m. The engine is attached to the mount by two special fittings at "A" and "B". "C" is the oil tank and "D" the oil return pipe to the engine.



The new Ryan PT-21 Primary Trainer is powered by a Kinner R-54 engine. The exhaust ports, two of which are shown at "A" and "B", are connected to an exhaust collector ring "C" located behind the forward section of the engine mount. The manifold is at "E" and the port at "D". Two of the rear engine mounts are at "G" and "H".



The special engine shock mount designed for the Kee-Royce Model 7-G installed in the Rearwin Cloudster uses rubber for vibrating dampening. This rubber is placed at "A" between the fuselage attachment fittings and the structure of the mount. Note the forked welded fitting supporting this unit.



The Madsen gun installation in the Curtiss Hawk 75 export version, uses an 11.35 mm fuselage gun and a rifle calibered gun. "A" is the 11.35 mm fuselage gun. "B" is the rifle calibered fuselage gun. "C" is the ammunition box for rifle calibered cartridges. "D" is the ammunition box for 11.35 mm cartridges. "E" is the rear gun mount. "F" is the front gun mount. "G" is the solenoid for trigger device. "H" is the empty case chute.

Aviation RADIO

Dialing the Air Waves with Craig Walsh

New Plant for Airadio, Inc.

Airadio, Inc., Stamford, Conn has purchased the plant of Cmaudagraph Speakers, Inc. to enlarge its manufacturing space to 35,000 square feet. Machinery and fixtures were included in the transaction. Airadio now has complete transformer and sheet metal departments to facilitate the manufacture of custom built communication equipment. The company is building aircraft radio accessories as well as portable transmitters and receivers. The president of Airadio is M. B. Andrews who was formerly with American Airlines as supervisor of radio equipment.

General Purpose Aircraft Receiver

The Model AR-10-A general purpose aircraft receiver manufactured by Harvey-Wells Communications, Inc., of Southbridge, Mass., was especially designed for use in scheduled air transport service and is therefore rugged enough to withstand rough usage with no ill effects. Both the communication band and the beacon band are covered. The communication band is continuously variable from 2,500 to 4,500 kc. and from 4,500 to 8 000 kc with provision for 12 crystal controlled frequencies anywhere in the band. The beacon band is also continuously variable, with provision for quick shift spot tuning on 271 and 278 kc. or any other two specific frequencies in the beacon band.

This receiver is flexible enough so that it can be operated under a variety of conditions. The power supply can be either 12 or 24 volts d.c. or a.c. supply can be used with independent d.c. relay control circuits. An internal or external source for B voltage can be used since a plug-in type of dynamotor unit is supplied within the receiver. The receiver also has a self-contained tuned loop amplifier and matching circuits.

A single tuned circuit is used between the antenna and the grid of the r-f amplifier. Three antenna input terminals are provided, one for the low frequency beacon antenna, one for the high frequency communication antenna, and one for the loop input on the beacon band. Two i-f amplifiers with six tuned circuits operating at 455 kc. are used. The audio output level is held constant within plus or minus 6 db for input voltages from 5 to 100,000 microvolts by the a-v-c circuit. The power output is 300 milliwatts through two independant output channels. This unit will fit into a standard ½ ATR space which is approximately 19½ in. by 4⅛ in. by 7⅞ in. Its weight including crystals, tubes, dynamotor, and the band change mechanism is about 24 lb.

U-N-F Communication System For Flight Instruction

An ultrahigh-frequency ground-to-plane communication system operating on a single frequency in the 30 to 40 megacycle band is being manufactured by Air Associates, Inc., Bendix, N. J. It is intended for the use of flight instructors remaining on the ground to contact students flying above them. The system consists of a 50-watt ground station transmitter and an aircraft receiver which can be placed on the seat of the plane alongside the student, or may be securely fastened by a special clamp.

The UHT-40G transmitter is contained in a case 17 inches wide, 10 inches high, and 10 inches deep which is intended for either rack or table mounting. It is designed for remote control so that the instructor is allowed considerable freedom in his movements. It draws approximately 5 amperes at 115 volts, 60 cycles.

The UHR-40A receiver is 4¼ inches wide, 3⅞ inches high, and 7½ inches deep. The only control is a single knob for volume adjustment. A trimmer on the front panel permits permanent friction-lock adjustment to any required frequency in the 30 to 40 megacycle band. It is powered by two dry cells, contained in the receiver chassis, and will operate for 100 hours before battery replacements are necessary. The receiver is designed for use with a simple vertical whip antenna.

New Set Tester Developed In American Airlines Radio Shop

Ralph Core, radio shop foreman for American Airlines, has developed a new test set to test all receivers used in the Flagship fleet. The sets are operated under condition simulating actual conditions so that troubles can be located quickly and accurately. Provisions are made for the testing of future receivers merely by the addition of new plugs to accommodate the new sets. The new unit is used by all repair mechanics and by the inspectors in the final check and alignment of the receivers.

Ralph Core, American Airlines radio shop foreman, and his newly designed test unit recently adopted by the airline.

THE *Lockheed* LOG

LEADERSHIP

IN DEPENDABILITY

The brand of DEPENDABILITY provided by Lockheed has a deep-rooted heritage! It comes not from knowledge gained by building a single airplane...or even a hundred airplanes. It comes from the production genius necessary to build more than a *thousand* high performing, two-engine airplanes... airplanes of all types for all jobs...airplanes that have remained up-to-date and popular in the rapid progress of aviation...airplanes that have become famous for outstanding operating characteristics.

"Serviceability" has come from the experience that built the still modern Lockheed Electra. "Stamina" has sprung from the design of an airline transport that was transformed, almost overnight, into the rugged "Hudson" bomber. And "Performance" was provided by an engineering organization that has produced the "Lightning" fast P-38 Interceptor Pursuit for defense.

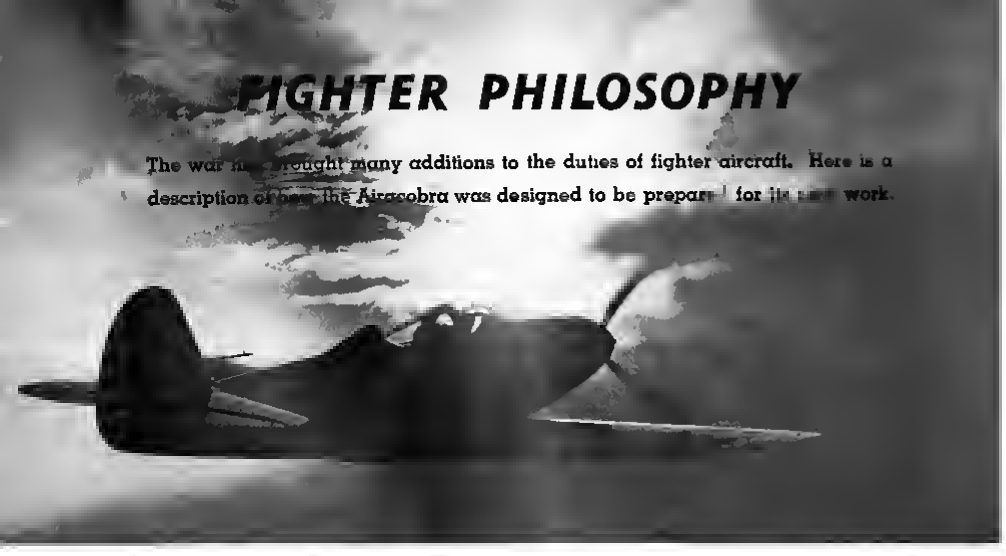
Individually these characteristics are important...together they form a combination that spells *Dependability*...for leadership! They are the reasons that Lockheeds operate with equal efficiency in both Arctic cold and Equatorial heat. They are the reasons that fast schedules and difficult terrain are met with economy and absolute minimum of maintenance.

When you come right down to it—*the men of Lockheed* are the real yardstick—the best guarantee of Lockheed "dependability." The world's finest machinery—the best available material—even the most modern industrial processes—all things that Lockheed provides—can never be more than instruments to be used by their capable, well-trained hands

It is the *men of Lockheed* themselves, who actually "build in" the kind of "dependability" that has made Lockheed famous. Each airplane as it moves through production, becomes a personal interest—an object of pride to those who build it. And when it wings its way to a new life, it carries with it a "pat on the back" and a guarantee from 29,000 *men of Lockheed*

LOOK TO *Lockheed* FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION • BURBANK CALIFORNIA, U.S.A.



FIGHTER PHILOSOPHY

The war has brought many additions to the duties of fighter aircraft. Here is a description of how the Airacobra was designed to be prepared for its new work.

By Lawrence D. Bell, *President and General Manager, Bell Aircraft Corp.*

DURING the six years at Bell Aircraft Corp. in which we have been building airplanes, we have always tried to understand completely the problems involved in fighter aircraft construction before we began building the ships. In other words we analyzed the philosophy of, and the reason for, fighter airplanes, and then set about the task of building craft worthy of the name of fighter.

We tried to think of the airplanes we wanted to build in military terms. What they should be able to do, assuming of course that they were equal to or better than other craft with respect to high speed, ceiling, rate of climb, maneuverability, etc. We realized that many other people building airplanes had always thought in terms of the vehicle, and realized that perhaps we were sticking our necks too far when we began to think in terms of fire power instead!

But we were not fooling ourselves about being able to build an airplane so much faster than anyone else so that for that reason alone we'd be able to get all the business we could handle. We knew very well that with horsepower, size and wing loading the same, there was no reason why three or more capable aircraft manufacturers couldn't build planes which would have about the same high speed, ceiling, rate of climb, maneuverability and other performance characteristics. And we also knew that unless we could build a better job, incorporating superior features, we wouldn't have much of a selling point when we went to our potential customers, the Air Corps and the Navy, and asked them to give us the orders they had been giving established builders. We knew also that the airfoil sections we could use and the engines available to us were at the disposal of all other manufacturers.

Larry Bell

We went back to fundamentals. Philosophy, if you like.

We looked back over history, and saw countless examples of the truth that victory most often comes to the side with the greatest firepower. When Hannibal crossed the Alps with a circus parade of elephants, he was bringing into play against the defending Romans a brand of firepower which was devastating. When William the Conqueror stormed the heights of Senlac in 1066 he was utilizing firepower which was more than King Harold and his Saxon warriors could withstand.

John Paul Jones, perhaps our nation's most daring naval hero achieved invincible firepower during the Revolution when he armed his craft with long guns, taken from the cradles of land forts. Development of the tank during the World War gave the British a decided firepower advantage over the Huns, an advantage which some military experts credit with having tipped the scales in the Allies' favor at a critical moment in the course of the first World War.

In a very real sense, we at Bell Aircraft were reading history for the lessons we could apply to military aircraft. We were thinking in terms of firepower. We were thinking as John Paul Jones and the British had done.—We were probing the possibilities of moving firepower to the front line of wars to come. In '76 it was the sea. In the first World War it was the no-man's land between the apparently invulnerable line of German trenches and the ranks of the attacking Allies. In the second World War—as we saw the picture in 1937—it was to be in the air!

We asked ourselves what a fighter should be able to do, and then looked at the best of the current models to see what their short-comings were.

Three qualities were vital to a successful fighter, as we saw the problem, and none of the existing aircraft had them in what we felt were necessary amounts. They were: (1) Sufficient fire power, (2) improved landing and ground handling characteristics, and (3) greater vision.

With respect to No. 1, we knew that no bigger bullets were needed to put a man out of action in 1937—when we began the Airacobra—than during the previous World War. But we envisioned a fighter airplane which would be able to do more than injure or kill unprotected individual men among the enemy forces. We thought of an airplane which would be able to fire an explosive shell powerful enough to cope with panzer divisions and mosquito fleets. Yes, of course, a fighter capable of vanquishing the biggest bomber.

In the present war, according to the picture we had back in 1937, fighter airplanes would have to operate under far less ideal conditions than those provided by super airdromes. They would have to be able to get off improvised fields and perhaps even highways. They would have to take off cross-wind, if necessary. And they would have to operate at night without the aid of million-candlepower floodlights.

Not only that, but we knew fighter pilots, when fatigued from the strain of combat, would need to be relieved as much as possible from the responsibilities which conventional landing gear presented. The only answer, as we saw it, to Item No. 2 was tricycle landing gear.

The demand for speed and more speed had, naturally enough, resulted in bigger engines. And the bigger engines had robbed fighter airplanes of a characteristic we considered vital: Good visibility. We had to devise some new arrangement of the equipment of our new fighter airplane so that visibility, forward, sideward, down and aft would be guaranteed.

The key to all three of these problems was the extension drive shaft—that method of transmitting power from the engine which had been used for as long as a century on ships and every other vehicle except the airplane. Even the first airplanes, it was to be remembered, had designs embodying transmission of power from the engine through bicycle chains to propellers!

Airplane manufacturers in 1937 probably were agreed that such a drive shaft installation was possible but they had hesitated to risk the effort and expense of developing this method of power transmission. Moreover, it is doubtful if many plane builders visualized the full value of the three-fold benefits to be gained from this arrangement. Our successful undertaking of the design and installation of the drive shaft in the Airacobra was materially aided by the never ending counsel and help received from the Air Corps and the Allison Division of General Motors.

Before I go further, full credit should be given those far-seeing officers of the Air Corps who encouraged us at Bell Aircraft to continue our development of air-borne firepower. Except for the wisdom and inspiration which was forthcoming from Maj.-Gen. Henry H. Arnold, Brig.-Gen. George C. Brett, Brig.-Gen. George C. Kenny, Brig.-Gen. Frank M. Andrews, Brig.-Gen. Oliver P. Echols, and the late Col. Earle C. Robbins, our ambitions could never have been realized.

Our role as a pioneer advocate of smashing firepower for airplanes could never have been played except for the support we received from the Air Corps personnel. Their recognition of what was needed and their ability to encourage the practical development of those needs is reflected today—years after the seeds were planted—in the mass production of fighter planes packing plenty of firepower. Six and seven years ago, we were an experimental station for the development of firepower and the success of our work was in great part due to the vision of the Air Corps.

To a very important degree, the Airacobra as it flies today, hurling through the air with a 37 mm. cannon, is due to the Air Corps. Back in 1937 we entered two designs in the Air Corps fighter plane competition. One was substantially the Airacobra, with 10-ft. drive shaft and engine located behind the pilot. The other was a more conventional model, utilizing numerous refinements but with the engine located in front of the pilot. It was the Air Corps which chose the Airacobra design, with its superior vision obtained from the aft position of the engine.

Before explaining in more detail why we designed the Airacobra so as to make use of the drive shaft, let me go back a little to the development of the Airacuda. In this bi-motored multi-place fighter, we had utilized drive shafts, to transmit power from the two Allison engines to pusher propellers. To be sure, the drive shafts were comparatively short compared to the 10-ft. shaft engineered into the Airacobra design, but the principle had been successfully adopted for aircraft use.

With respect to firepower, the Airacuda was also outstanding. Details of the armament and fire control arrangement of this airplane are still restricted but one may say that this craft incorporated a very accurate range finding device, connected to an automatic computer, for the firing of the two 37 mm. cannon carried.

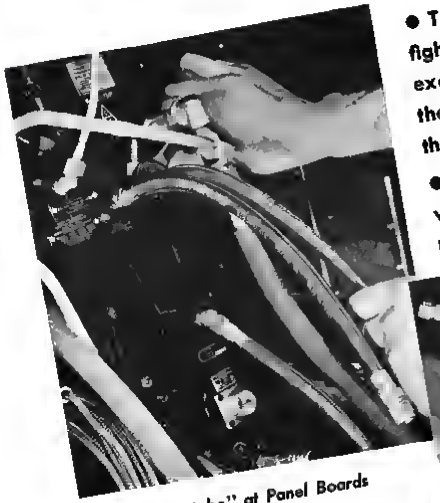
The function of the fire-control equipment is essentially the spotting of the target in the line of view of the telescope which is part of the range finding equipment, to determine the range of the target from the gun. An automatic and continuous adjustment of the gun to fire to the target is made electrically, with the proper corrections made in the gun pointing by the automatic fire control computer device. Compensation is also made for variation in relative positions during firing and allowance for time of flight of the shell from the

(Turn to page 90)

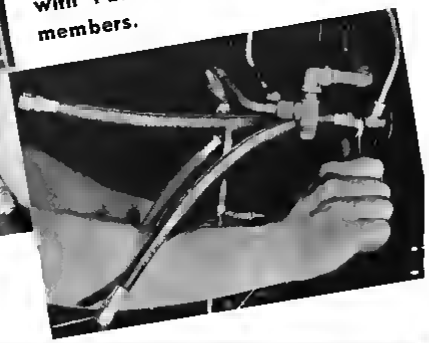
To do his best work a pilot needs visibility, something to shoot with and a ship that he can easily handle. These ideas went into the Airacobra.

MASTERY!

Airacobra P-39 in Flight



"Flex-o-tube" at Panel Boards



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Engineering the Airacobra

By Harland M. Poyer,
Chief Engineer, Bell Aircraft Corp

THREE years ago, two pursuit airplane designs were conceived at the Bell Aircraft Corp., and preliminary engineering was started. One was a conventional airplane with noteworthy features, what might be termed a conservative up-to-the-minute design, embodying what was known in aircraft circles as good practice, and probably well able to hold its own with the pursuit planes of its time.

The other was somewhat radical in design as compared with existing airplanes. While its exterior was exceedingly smooth, representing the ultimate in streamlining and eye appeal, its interior arrangement appeared to present insurmountable engineering problems. The engine was located amidship, the pilot was placed forward of the engine in a cabin with automobile-type doors "for easy ingress and egress," an extension shaft ran forward to a gear box located in the nose of the fuselage, and no oil or prestone coolers were in evidence. The apparent lack of structure was alarming. However, this airplane was designed to be the outstanding airplane, not only of its day, but for three years hence.

Gradually the intervening years have disclosed to the world that that airplane was not a designers' nightmare. It embodied no radical engineering features. Sound engineering principles, although at first sight not apparent, have since been proven to exist in its design. It was conceived to fill a definite need, and dogged determination through the design, construction and testing of the prototype airplane has insured accomplishment of that purpose.

The objective of the designers was an interceptor pursuit airplane, outstanding in its ability to accomplish a deadly purpose. This meant firepower lots of it, and sufficiently heavy to stop enemy bombers. It meant ability to climb speedily to a high altitude and be in position to strike when occasion demanded. It meant plenty of speed to overtake the bombers, maneuverability and vision to enable it to fight off enemy pursuit craft. To sacrifice any of these essentials would lessen its value and would have resulted in just another pursuit plane.

Looking at the Airacobra from the design standpoint, the extension drive shaft merits attention. It has repeatedly been placed in the spotlight, and justly so. It is a remarkable development, not because of any involved engineering problems, but rather because of the possibilities it presents for improvement of aerodynamic characteristics, vision, maneuverability, and accessibility as well as greatly increased fire power.

There is nothing remarkable about the fact that the engine is not located in the nose of the airplane. As a matter of fact, as the criteria for design was being worked out, we began to wonder why that select spot had ever been assigned to the engine.

The problems encountered in the structural design of an airplane are always fundamentally the same. They involve first, an analysis of all possible loading conditions, and second, the design of a structure to withstand those loads and allow all mechanical units installed in the airplane to operate successfully under the deflected conditions of the loading structure. The design of the extension shaft was no exception to this rule. While it is true that no criteria for the design of this conventional installation existed in the "Handbook for Airplane Designers," we were not greatly perturbed, having become used to this condition on the Airacuda (the multi-place, bi-motored, cannon-carrying fighter we previously built).

Therefore, all possible loading conditions were studied from take-off, through all maneuvers, dives, spins, accelerated pull-outs and landings. Many conditions were investigated such as propeller gyroscopic, and gear box torque loads, which had been of little concern to designers of more conventional aircraft. Shear and moment curves were plotted for all combinations that could exist simultaneously. The fuselage structure was then designed to withstand the loads and to provide a platform for the 37 mm. cannon and the .30 and .50 caliber guns mounted in the nose as well as a rigid and satisfactory mounting for the gear box and intermediate shaft support bearing. It is not uncommon in modern aircraft to design structure from the deflections standpoint, in fact, practically no strength calculations ignore them. Therefore, deflections were computed and curves plotted showing the greatest deflections that would be encountered in service. Using these calculations as a basis, engineers of the Allison Division of General Motors Corp. worked with us hand-in-hand, and designed the shaft to meet our requirements.

The fuselage structure of the Airacobra is so designed and tooled, and the installation of the engine such, that with the airplane in level flight, the engine crankshaft, and the two sections of the extension shaft are parallel. This means that under other conditions of flight or landing, the shafts are slightly out of parallel. A sufficient amount of universal action is provided at the front of the engine, at the intermediate bearing and at the attachment of the shaft to the gear box. Calculations, backed up by static test, prove that at no time are bending or end loads imposed upon the torque shaft by deflection of the airplane structure. It is, therefore, free running under all conditions including pull-outs so violent as to cause the pilot to black-out.

The principle of the extension shaft is basically sound, all possibilities of loading having been anticipated and investigated, which accounts for the fact that this part of the airplane has been 100 percent trouble free.

Another engineering problem was the development of the tricycle landing gear. In the early stages of development of the P-39, our engineers recognized the fact that the trend toward higher landing speeds had reached the point where improved ground performance and reliability had become a vital factor in the success of any type plane to be built. Realizing the advantages which might be obtained by the use of a tricycle gear, it was decided to do some real research and experimenting with this type.

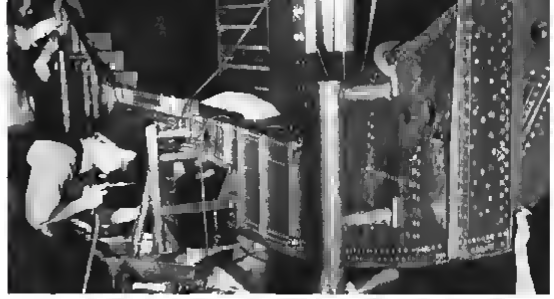
A landing gear test vehicle was built, with weight, balance, tread and wheel base dimensions similar to that proposed for the actual airplane. Considerable expense and many months of effort were expended in the exhaustive tests conducted with this "test-cart," which included runs over all types of fields from soft, rough sod to loose cinders and concrete. Many of these runs were made at speeds up to 70 mph and obstacles representing large rocks and deep ruts were placed in the path of the nose wheel to determine its ability to withstand all operating hazards which might later be experienced. The reward for this extensive research is evident today. The Bell Aircraft Airacobra is the first single engine pursuit type airplane employing a tricycle landing gear to be put into quantity production.

The main wheels of the P-39 are equipped with high pressure tires and hydraulic multi-disk type brakes. Provision has been made for installation of oversize wheels and tires if desired. The nose wheel is a standard smooth contour type, similar to that used as a tail wheel for larger airplanes. No brake is installed in the nose wheel, but a puncture-proof inner tube is used.

Shock struts on both main and nose wheels are the air-oil type with adequate strokes to absorb the energy resulting from severe landings. The nose wheel swivels 60 deg either side of center permitting short radius turns. A noteworthy design feature which has contributed greatly to the outstanding performance of this gear, is a hydraulic device in the nose wheel strut which automatically dampens the swiveling action of the wheel, eliminates shimmy, and improves the stability under all operating conditions. Off the ground, the nose wheel automatically returns to its exact center position so that it can be retracted into the forward fuselage.

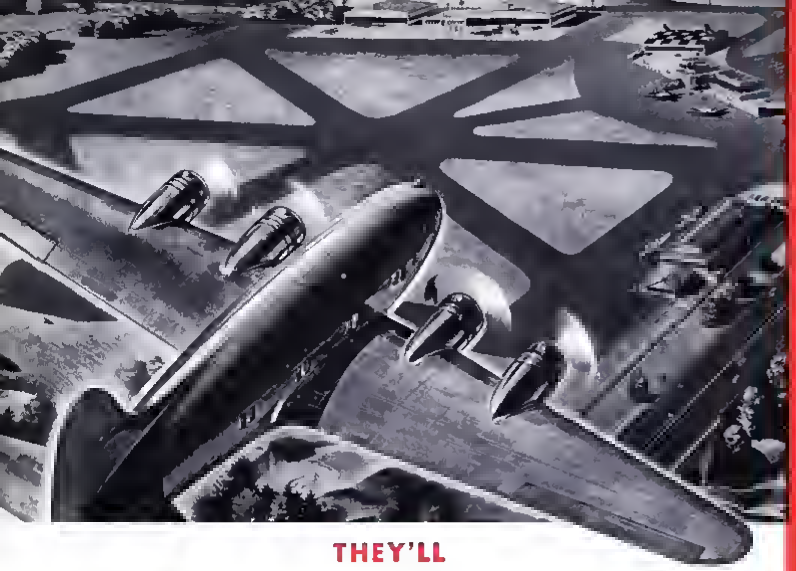
All three wheels are retracted simultaneously by an electric motor operating through a suitable gear reduction. When in the retracted position, all wheels are completely covered by smooth flush-type fairings which are actuated automatically and require no attention from the pilot. The use of a "cone-

(*Turn to page 92*)



Workmen building up one of two longitudinal beams which make up a forward fuselage structure.

Attaching skin to two longitudinal beams which will later be joined together to form a forward fuselage.



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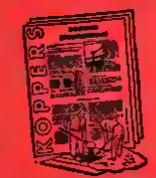

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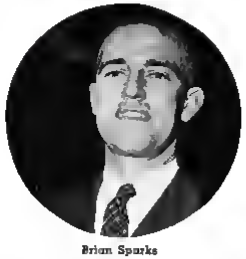
The tricycle landing gear of the Airacobra required some new ideas to be applied to the testing procedure

Test Flying A Ball of Fire

With the radical design of this fighter aircraft new tricks had to be applied for its flight testing.

By Brian Sparks, *Chief Test Pilot and Head of Flight Research*



Brian Sparks

DEVELOPMENT during the past five to seven years of high performance airplanes—with speeds topping the 400 mark—has required an entirely new technique in test flight work. And this, in turn, has required an entirely new type of test pilot,—a test engineer, if you will, capable not only of flying an untried craft but also of gaining worth-while scientific information from such flights.

In the Airacobra, the need for a new test flight technique and a different type of test pilot was perhaps more obvious than on some other planes built about the same time. This, of course, was because in 1937 the construction of single engine fighter airplane with tricycle landing gear, engine behind the pilot and 10-ft. drive shaft made the craft completely unique. Besides, the 400-mph speed of which the P-39 seemed capable, presented test problems previously unencountered.

And so it was that the test work on the Airacobra, begun in 1937, hastened the transition of flight testing from an adventurous past to a scientific present. To the worth-while efforts which had been made in the past were added new methods, from which scientific information was sought.

Formerly, the process of testing a new ship was similar in many respects to the technique with which a prospective automobile buyer "tries out" a new automobile. If the plane flew reasonably well, the pilot said so. If not, he sought to describe the reasons, but the information obtained in this fashion was little more illuminating, or precise, than the "it rides nice" which one often hears from the prospective car buyer.

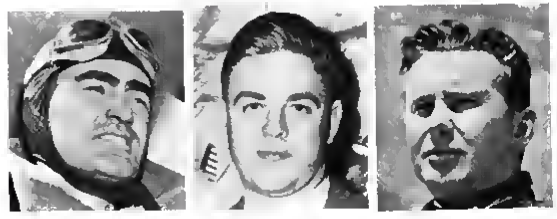
Individual opinions on proper flight characteristics of an airplane were as widely divergent as the pilots themselves. Not only did personal standards of requirements vary, but the opinions formed on the basis of flight tests were often hopelessly confused by unrealized inter-relations of distinct basic factors.

For example, control forces are a decidedly separate though related entity from airplane stability. In the past, pilots almost universally gave a verdict of stable to such airplanes as had high control forces, whereas scientific research has since disclosed that often an airplane with high control forces may be very unstable. When it comes to airplanes of the "400 class," correct information has to be obtained, and the day when all a test pilot had to know was how to "fly by the seat of his pants" is very definitely past.

We found that one of the main sources of trouble in securing usable information from flight testing was a fault attributable to both engineers and pilots—neither understood completely what the other was talking about. The way a pilot put it to me is about right, I think —"An engineer is a man who learns more and more about less and less until finally he knows everything about nothing, while we're the chaps who learn less and less about more and more until finally we know nothing about everything!"

The excellent research program of NACA in developing quantitative flight characteristics standards has assisted greatly in solving this diverging dilemma. In the four years since the Airacobra flight testing began—perhaps one should go back a year or two before that to the days of the bi-motored Airacuda with its own host of engineering developments—we have secured some fairly definite ideas about what relative control force ratios should be for a "good" airplane, and the accumulation of results on stability measurements of proven satisfactory types has provided other material to clarify the solution.

Today the test pilot (from now on I shall refer to him as the test engineer) has a much more definite test program to follow, and a better understanding with the engineers about what the resulting answers mean.



Robert Stanley, Frank H. Kelley and Mark Heaney who help in sharing the responsibility of flight testing and service testing the Airacobra

Although the factors of flight performance, such as high speed, ceiling, stalling speed, rate of climb and so forth, are definite measurable quantities, the reduction of such flight measurements to standard figures has given rise to considerable confusion in the past. Only recently have methods been developed which give reasonably consistent results. With the development of each new type of craft, new difficulties are found, and flight research must progress rapidly to keep in step. In the case of the Airacobra, this progress was multiplied, because so many new engineering features had been incorporated into the makeup of this interceptor pursuit craft.

Flight testing may be classified, generally, into three principal sections — performance, flight characteristics and the catchall, miscellaneous. Technically, one might describe these categories as; motion with respect to space axes, motion with respect to wind axes, and mechanical tests.

Performance is concerned with what the airplane actually will do in "covering" space. Flight characteristics involve determination of longitudinal, lateral and directional stability, control forces for various conditions of flight. In the miscellaneous grouping will be found less vital tests, including instrument functioning, lighting, heating and ventilating installations, cockpit control arrangement and other matters.

Naturally, the two first groupings are the most important, and also the most complicated from the flight test standpoint. Accumulation of data from past years of test results forms the basis for any test program, but the testing of a high performance ship like the Airacobra pushes the frontiers much farther, and occasionally we were forced to introduce test methods which were based on theoretical analysis to achieve reliable results.

For example, in testing a 400 m.p.h. airplane, we were immediately aware of an obvious source of error,—the effect of compressibility on the airspeed measurements. The analysis by Zahm shows that the effect may amount to as much as 7 percent at 400 m.p.h. Careful alignment and location of the pitot static head was found to be desirable to avoid local interference. If the pitot static head is not parallel to the direction of airflow, errors are introduced and for some conditions, corrections were made to offset misalignment caused by changes of angle of attack.

A most satisfactory method of airspeed meter calibration, used by NACA, where a calibrated head is suspended below the airplane by connecting tubes, was found impracticable for a single-seater fighter such as the Airacobra, and as a result we were forced to rely on calibrations over a speed course laid out on the ground. A novel method

(Turn to page 96)

One of the first Airacobras in which some of the armament was installed. The markings on the nose indicated that a cannon was equipped on the plane for test firing.

Fighter Philosophy

(Continued from page 75)

gun to the target. This fire control equipment was developed in cooperation with the Ordnance department, under the direction of the Air Corps. Besides this, the Airacuda incorporated power driven turrets!

All this had been accomplished before the Airacobra was built. With respect to the single-engine fighter, what we wanted was a craft capable of carrying an explosive shell-firing cannon on the centerline. Even at that time German aircraft manufacturers were installing 20 mm. cannon between the banks of the cylinders of their vee-type liquid-cooled engines so that they fired through hollow propeller hubs.

These 20 mm. cannon weren't big enough to satisfy our requirements, and Air Corps tests had convincingly demonstrated the superiority of 37 mm. projectile over the destructive power of the smaller bore cannon. Even if we had wanted to make use of the plan adopted by the Germans, there was no engine in the United States or Great Britain which would accommodate any cannon, much less a 37 mm. So we had to place the engine somewhere else besides the nose of the ship.

Then we wanted tricycle landing gear. We wanted an arrangement which would have a generous tread for the rear wheels, and a long nose for the nose wheel. This would be impossible, if the engine were located in the nose. Forward position of the engine meant a short nose, and this meant a short wheelbase. And a short wheelbase made it impossible for use to obtain the generous tread we wanted for the rear wheels.

With respect to vision, we were again stymied when we sought to design a fighter with the engine located forward. Our design which won second place in the competition had room between the propeller and the engine for the cannon installation, but the pilot was located to the rear.

In designing our engine placement behind the pilot we moved forward into the nose the reduction gear, which is usually an integral part of the engine. In other words, the reduction gear was placed directly behind the propeller, with power being transmitted from the engine by the drive shaft. Besides all other advantages, this installation permitted speedy removal of the engine for overhaul and other service reasons without molesting the propeller, reduction gear, drive shaft or cannon installation!

What was the cost, in weight, for this advance in aircraft design? Precisely 50.7 lb. The drive shaft, 10-ft. in length, weighs but 40 lb., while the single center bearing weighs 10.7 lb. We gave the drive shaft hundreds of hours of testing on the block and under actual flight conditions, and its smooth functioning was beyond even our hopes. We designed the installation of this drive shaft so that during a terminal velocity pullout of 12 gs—more than any pilot could stand—the nose of the plane would deflect up to 1½ in. But the drive shaft was engineered so that it could take a deflection up to 2 in.

Let us consider for a moment the rewards gained from this engineering innovation in aircraft design. With respect to the 37 mm. cannon, we had shot into the sky a weapon capable of coping with the most potent weapons of mechanized cavalry divisions and mosquito boats. We had equipped an airplane with a weapon firing projectiles against which it was impossible successfully to armor plate other aircraft. Nor could any leak-proof gas tanks be installed which would withstand the force of its explosive shells. In short, we had lifted anti-aircraft and anti-tank guns into the air!

Our tricycle landing gear gave us a fighter which could use four-lane highways for takeoff and landing purposes, more safely than many conventional pursuit planes could use a mile-square airport. In the event of wartime conditions, when landing fields would be bombed, or for emergency landings, our tricycle-geared craft was still safe to bring to earth. This applied no less strongly to night operations.

Reports of actual combat use of fighters during the present World War have strengthened our belief in the need for tricycle gear equipment. In the present war, in certain operations up to 75 percent of the losses have resulted from takeoffs and landings under bad conditions, particularly at night during stormy weather. With our Airacobra, it is possible to come in for landings at speeds varying from 80 to 140 m.p.h. For the first time, with respect to fighters, a plane had been developed in which the pilot didn't have to run out of altitude and speed at the precise moment he reached the proper spot on his landing field. And of course, ground looping has been eliminated.

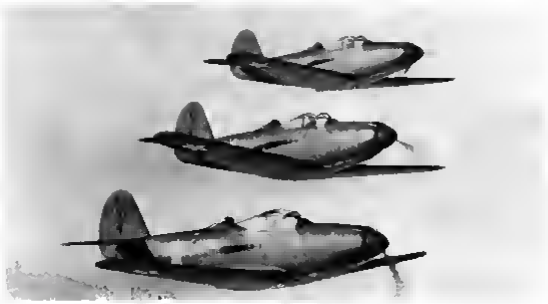
Improved vision beyond the obvious advantages it afforded, was to be important for several reasons which we didn't know about at the time. This war, with its greater use of night flying, and its tremendous demands upon the physical stamina of the brave young men in fighter defense, was to require an airplane in which tired pilots, coming back after grueling night battles to darkened airdromes, needed every particle of vision which careful design could give them.

Four years ago, I believe, many builders of aircraft confused the question of firepower. In their effort to improve their products, they thought only in terms of the number of small caliber guns.

Opposed to this opinion, we have always felt that the important thing was the size of the projectile—the force of the striking blow. I suppose one could take all the 16-in. guns off a battleship and in their place substitute perhaps 2,000 30-caliber machine guns. But the effectiveness of the dreadnaught would obviously have been lost during the transfer. And I am willing to concede that it might be possible to bring down a multi-motor bomber if you fired enough rice at it. But this procedure would be far more difficult than the firing of a well-aimed 37 mm. projectile, weighing 1.25 lb.

The 30-caliber machine gun certainly had its place in the aircraft of the first

(Turn to page 98)



Three planes of the first Air Corps Pursuit Squadron to be outfitted with Airacobras.

Airacobra

(Continued from page 79)

type" worm and gear, for retraction of the main wheels, is an interesting application of this kind of gearing to aircraft mechanisms, and it is designed to withstand severe landing loads in addition to its function in retraction. The high efficiency of the whole retracting system permits the wheels to be completely retracted in approximately 18 seconds, and to be extended in 12 seconds. An emergency hand crank is provided for manual operation in case of failure of the electrical system.

While equipment men argued that the purpose of the airplane was to get their equipment in the air, the structures men countered that its purpose was to keep the equipment there. The result was a well balanced design, which did all the designers asked of it. However, the demands of the present war-type airplane were not all foreseen at the time and the idea that a wartime airplane would be very similar, but with "peacetime equipment" omitted, has been proven incorrect.

War abroad has forcefully brought home to us the necessity of revising our ideas of what constitutes a wartime airplane. The addition, instead of elimination, of radio and instruments, armor plate, self-sealing fuel tanks, and additional armament have increased the weight by an amount which two years ago would have seemed inconceivable. The armament which seemed so adequate has been improved by the addition of four wing guns. In all, a total of 500 lb. has been added in armor plate and fuel tank protection, and the airplane carries more than ¼ ton of guns and ammunition.

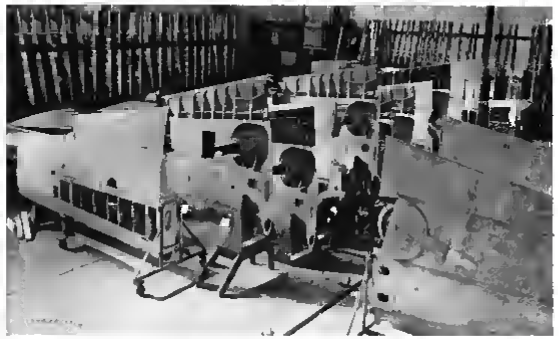
Likewise, prospects of war threw other complications into the picture. The Airacobra must be put into production. One of the most important considerations in production design is the interchangeability of parts. This has been accomplished by the elimination of all possible hand work, with a combination of accurate tooling and expert lofting making it possible. The P-39 airplane is by its basic design an ideal subject for mass production, if such a thing is possible at the present time in conventional aircraft manufacture. It is built up of numerous subassemblies. Principal among these are the forward and aft fuselage assemblies, the wing panels, tips center section carry-thru, superstructure, cabin, doors, landing gear and control surfaces. Each is designed to be as nearly as possible a complete unit.

Subassemblies incorporating all installations are built up in their own assembly lines which feed into the main assembly line in orderly fashion. Here the idea laid down of segregating all the various installations has proven a definite advantage. In the same manner the problem of servicing the airplane is solved. Several crews of mechanics may be working on various parts of the airplane without interfering with each other. The engine, armament and radio installations are in more or less localized portions of the airplane. Therefore adjustments and repairs are more easily accomplished.

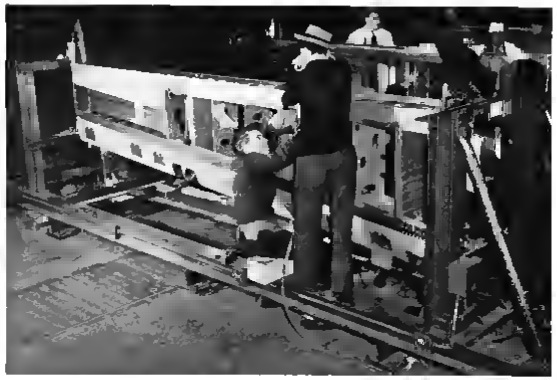
For evidence to substantiate our belief that we have licked the engineering problems associated with the development and quantity construction of the Airacobra, I can think of no better authority than Maj. Gen. Henry H. Arnold. I quote from a speech delivered by him before the Women's National Democratic Club at Washington, D. C., May 12 this year—

I can tell you that one of the world's fastest pursuit airplanes, the Airacobra, is now in production in the United States. This remarkable airplane is worthy of its name. It is armed not only with machine guns but with cannon as well. To facilitate operating these guns and provide better visibility for the pilot, the engine is located in back of the pilot. We expect great things of the Airacobra, in its final form with armor plate and its leakproof tanks.

In this day and age, our fighting planes with their keen, alert pilots must be able to climb rapidly high into the air—far above hostile bombers. They must be able to maneuver easily and have the speed to place themselves where they can blow their adversary's plane into a thousand pieces. That our Airacobra can do.



Wing assembly. Inspection panels utilize Camloc fasteners.



Jig for construction of forward wing assembly.

SALUTING THE BELL AIRACOBRA

THE DEADLY FLYING CANNON

Firing explosive shells from a cannon, the Bell Airacobra is one of the world's deadliest fighting planes. Its cannon fire is reinforced by sprays of bullets from its machine guns.

Deadly armament is made all the more effective by great maneuverability of these planes, built by Bell Aircraft Corporation, Buffalo, N.Y.

In test flights, for the safe lubrication of the Airacobras' 1150 hp Allison engines, Bell Aircraft relies on Sinclair Pennsylvania Motor Oil.

For further information about Sinclair Pennsylvania or other Sinclair aircraft engine oils, write Sinclair Refining Company, 630 Fifth Ave., New York, N. Y.

(Left) Test pilot. Cannon projecting through plane propeller hub.

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ELECTRONIC LABORATORIES, INC.

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Flight Testing

(Continued from page 85)

of clocking the start and finish times over this course was used, because it was difficult for the pilot to maintain high speed, plus steady flight, so close to the ground, and himself time the markers.

At each end of the course a man was stationed, at one end a timer with a stop watch, and at the other, a man with a set of photoflash bulbs. The watch was started when the plane crossed the first marker of the course, and was stopped on receiving a flash of flight from the finish lines. No difficulty was experienced in seeing clearly the flash in daylight, at distances of more than a mile.

Climb tests offered no particular aerodynamic or mechanical difficulties. Extra care had to be taken, however, to insure that time measurements in saw-tooth climbs (a series of climbs made at a number of predetermined air speeds and given power settings) were accurate, as the Airacobra disclosed exceptionally high rates of climb and the corresponding time intervals for moderate altitude range were relatively short.

At this point it may be in order to touch briefly upon one of the most important problems which we faced, a problem on which further research is now being conducted by scientists in this country and elsewhere. I am referring to a physical condition suffered by pilots, similar to the deep sea divers' enemy, "the bends." When the atmospheric pressure on the human body is suddenly reduced, bubbles of nitrogen gas form in the blood and interfere with normal circulation. This can and does happen during certain flight conditions, just as surely as it happens during deep sea diving. And the results may be just as drastic, sometimes fatal.

Today pursuit planes have reached speed and rate of climb characteristics which are quite capable of producing the bends, but four years ago this problem of air-induced bends was something new, although we knew that a test pilot for another company had been to the hospital for treatment following a flight which involved a long, rapid climb test.

During the flight tests of the P-39, prolonged climbs were avoided except when necessary, and the use of oxygen assisted in preventing any occurrence of bends. In addition, the test program covered a considerable period of time, and we have since learned that the pilot undergoes a certain amount of physical adjustment, when repeatedly exposed to rapid atmospheric pressure drops. Recent medical research has also shown that breathing pure oxygen is of material aid in developing increased resistance to bends by reducing the average nitrogen content of the blood. The usual service type of oxygen supply was used which increases the proportion of oxygen breathed, and it is possible the continued use of this richer oxygen breathing mixture, over a period of time during the altitude testing work, induced a certain amount of immunity.

It was to be expected that directional stability tests would be necessary as the fuselage of the Airacobra presents a quite clean streamlined shape. Here again, we know in 1941—but not in 1937—that the shapes of high performance airplane fuselages have materially lowered directional stability.

To conduct our stability measurements quantitatively, a yaw vane, resembling a wind vane, was installed on top of the cabin, and intentional sideslips were made during various conditions of flight. We found that with the original experimental vertical tail, rather large angles of sideslip could easily be produced, and that at the highest angles, rudder instability appeared. Increased fin area was required, and the alternative solution of dorsal fins was satisfactory. Our final design decision was made on a basis of structural considerations.

Longitudinal stability and control is a critical factor for high speed pursuit planes, but it is becoming increasingly difficult to achieve the desirable range of stick motion and control forces for both high speed and low speed conditions. Consequently, a rather detailed investigation was conducted on both longitudinal stability and control. Stick force and deflection measuring devices were installed and tests were made of the actual quantities obtained in flight for relatively large ranges of speed, power on and power off, and considerable shift in center of gravity location.

Particularly interesting to us were the effects of center of gravity shift. In an exaggerated rear position, not found in operating conditions, stability decreased greatly and the long period "roller coaster" oscillation known as the phygoid became undamped.

In other words, the airplane would perform a beautiful climbing and diving maneuver, with a period of about 50 seconds for the entire cycle. This resulted after an initial violent start had been obtained. Trim for this extreme position of the CG reversed, so that power off caused the nose to rise, and power on caused descent. At the same time, control became quite sensitive.

Because the maximum range of CG travel for all possible loading conditions never reached this exaggerated rear position, the information gained was of general interest only, and contributed to the quantitative data obtained regarding the efforts of movement of center of gravity in fighter planes in a speed range wherein the Airacobra was a pioneer.

The Airacobra incorporated a relatively new type of radiator installation, set in the leading edge of the wing and exhausting cooling air near the trailing edge. Full scale wind tunnel tests failed to check completely flight tests results, so exhaustive tests were made with progressive modification of the duct arrangement until the optimum design was secured.

Cooling in climb was critical and climb tests were difficult to obtain with sufficient accuracy. Because of the high rates of climb, all of the pilot's attention had to be concentrated in maintaining constant power and steady rate of climb. Therefore a photographic recording box was installed inside the nose of the fuselage, with a duplicate set of instruments. All readings could be instantly recorded by simply pressing a button on the control stick. The setup proved to be invaluable in reducing pilot effort, and also in increasing the accuracy of measurements.

Air loads on the flaps and landing gear were measured by installing an ammeter and voltmeter on the recording panel and determining the power required by the electric motor to retract and extend the gear.

Problems met and solved in testing the Airacobra may be expected in any new design. We ran into more problems than usually would be the case for two principal reasons—(1) The Airacobra was developed during the transition from 300 m.p.h. to 400 m.p.h. airplanes, and some cut-and-try methods of testing which were good enough for the earlier planes no longer were acceptible. (2) The Airacobra contained many more engineering innovations than would be found in the usual "new airplane."

But the science of flight testing has not become static. Flight engineers must advance, in step with the design engineers. Already new problems are looming over the horizon, demanding that answers be found. Military speeds, forced by the needs of World War II, are pushing toward the 450 m.p.h. mark, and the day seems not too far distant when 500 m.p.h. will be fact instead of fiction. Perhaps by then the methods we used will also have become obsolete or inadequate.

Among the problems which the flight engineers must solve are the effects of compressibility, which will become more and more appreciable. This is going to be hard to do, because simple laws used in ordinary methods of data reduc-

tion don't always apply. Exhaust-driven superchargers introduce new and complicated factors into the determination of power output, and extensive research will be required to evaluate them. The possibility of hydraulic power transmission destroys the usual relation of engine speed to propeller speed and introduces complications in interpretation of results. Harnessing potential power in exhaust gases for propulsion presents a host of problems, for which there are no answers in the back of the 1941 flight engineer's book.

As each problem arises, methods will have to be developed to solve them, and flight testing will become more than ever a highly technical profession. A job that will ever require more training. Also one which will present more satisfying rewards!

Fighter Philosophy

(Continued from page 90)

World War, but it has no place in the present, and we are at last almost agreed on this point.

Much has been said about the relative merits of the multi-motored bomber and the single-engined fighter pursuit. Take, if you will, a four-engined bomber. Install on it four turrets, one in the nose, one in the tail, one in the belly and one topside. Assume that each turret has a 37 mm. cannon, which can be aimed by the gunners. Assume, also, that this air giant has no blind spots.

As an attacker, take an Airacobra, with its 37 mm. cannon on the centerline. From any angle of attack, it is an even match for the bomber. Except for the difference in the size of target which the two craft present.

But what happens if the big bomber is simultaneously attacked by two or three or six Airacobras each with its 37 mm. cannon? From different directions? What then?

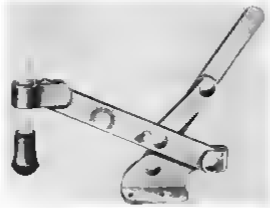
As I have said before, we at Bell Aircraft hold no secret to the production of high performance airplanes. We know no secrets which are forbidden to the other manufacturers. Such success as we have enjoyed during these past six years has been due to the fact that we were armament minded. Every plane the company has ever built first considered armament location, and we have paid so much attention to this phase of aerial warfare that we have developed a large ordnance division specializing on recoil and automatic feed mechanisms for aircraft and antiaircraft guns.

That's the philosophy behind the Airacobra. Realization of the basic reason for fighter airplanes—winged weapons with a knockout punch!

BUYER'S LOG BOOK

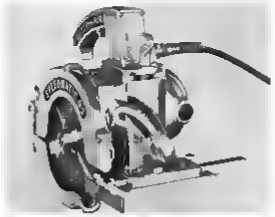
What's New in Accessories, Materials, Supplies, and Equipment

Aircraft wing or parts manufacturers should be interested in a new small light weight toggle clamp brought out by *Detroit Stamping Co.* Detroit, Mich. Intended for holding parts during welding, drilling, machining, assembly, and other production operations, the clamp is made of cold drawn, tough cadmium plated steel weighing only 9½ oz. measuring 6x6x1 3/16 in. A special rubber bolt head to fit ⅜ in. bolt is furnished with each De-Sta-Co Model 200 Junior Clamp to avoid marking or denting of surfaces being clamped—AVIATION, *July, 1941.*



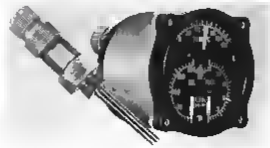
Detroit Toggle Clamp

Announcing another Speedmatic Saw, *Porter-Cable Co.* Syracuse, N. Y., have a new light weight high-speed electric hand saw, Type K-65. Machine, equipped with a ¾ hp. Universal motor, carries a 6½ in. diameter blade, with a cutting capacity of 2 in. material, yet weighs only 15½ lb. Base raises and lowers for depth adjustment, and tilts to 45 deg. for bevels. Manufacturer says that through use of the helical cut gear drive in this tool 98 percent of the motor power is transmitted to the drive shaft in comparison with 76 percent usually delivered in worm gear driver speed saws. Standard equipment includes combination saw blade, ripping guide, cross-cutting guide, 15 ft. insulated cable with plug and socket, and blade change wrench—AVIATION, *July, 1941*



Porter-Cable Electric Hand Saw

An aircraft engine gage, produced by *Thomas A. Edison, Inc.*, West Orange, N. J., combines three independent elements in one instrument. These are (1) an electrical resistance thermometer to indicate oil temperature; (2) an oil pressure gage, and (3) a vented fuel pressure gage. In normal operation the three pointers form an inverted T which facilitates rapid reading. Any deviation from the normal is immediately apparent. Use of electrical type thermometer eliminates necessity of a sealed vapor pressure system connecting instrument with temperature bulb. Instrument is offered in standard form for operation on two voltages. Type BV-12, for 12-v. battery (calibrated at 14 v.), and BV-24, for 24-v. battery (calibrated at 27 v.). Certain modifications of this standard form are available—AVIATION, *July, 1941*



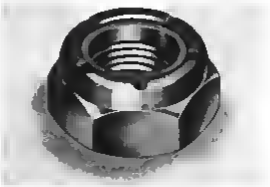
Edison Engine Gage

Newly designed airplane pump is announced by *Eastern Engineering Co.*, New Haven, Conn., which is entirely explosion proof, is compact, and can be mounted in any position. Approved by the Air Corps, it will operate in lines having static pressure up to 150 lb. sq in., and is designed for use as a booster fuel pump and in heating or refrigerator systems. Called Model AIR-1 Aeroplane Pump, it is the centrifugal (open impeller) type, having a maximum pressure (water) of 28 lb./sq. in.; (gasoline) 25 lb./sq. in.; maximum capacity (water), 8 gal. per min.; (gasoline) 6½ gal. per min. Pump body is made of duralumin with the impeller of bronze and shaft of stainless steel. Size—8⅜x4x4 in., weight 4.2 lb.—AVIATION, *July, 1941*

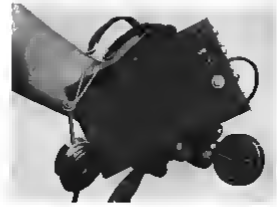
Eastern Airplane Pump

An increasing application of Bardco emergency standby electric generating plants to aircraft factory installations is reported by the *Bardco Mfg. & Sales Co.* of Los Angeles, Calif., and Dayton, Ohio. Chief feature of new Bardco standby equipment is ability to pick up full power load within 3 sec. after interruption of primary power source. Automatic controls also stop the plant a predetermined number of minutes after resumption of normal power. Units are available in capacities from 5 KVA to 200 KVA and can be operated in parallel to handle loads larger than 200 KVA. Engines to burn gasoline, natural gas, butane or diesel fuel are supplied.—AVIATION, *July, 1941*

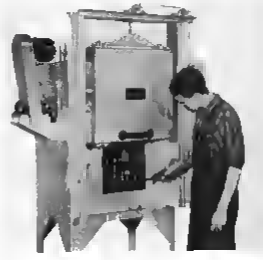
For use on shear bolts where a high degree of stress is lateral, and for general application to light and medium stress fastenings, an improved line of thin hex nuts is announced by *Elastic Stop Nut Corp.*, Union, N. J. Developed to meet demand for a self-locking fastening which offers savings in space, weight and cost, these nuts have about 40 percent of the strength of standard-height hex nuts, and are approved by all military and civil authorities. Self-locking action is accomplished by vulcanized fiber collar built into head of nut, as in standard-height Stop-Nuts. Thin hex nuts are available in steel, brass and aluminum in a complete range of sizes—AVIATION, *July, 1941*



Elastic Stop-Nut Thin Hex Nuts

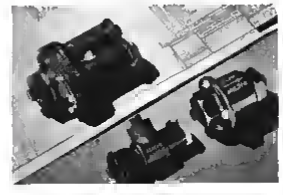


Mellaphone Inter-Communicator Unit

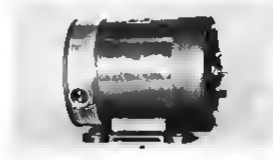


Despatch CF Type Furnace

New Type AC Spark Plug



Kenyon Check-Relief Valve



Quality Alternator-Drive Motor

Communication between instructor and student in pilot training is greatly facilitated by the new Aviation Inter-Communicator Unit developed by *Mellaphone Corp.*, Rochester, N. Y. Consisting of amplifier, microphone and earphones, the amplifier, complete with batteries and tubes, is small enough to fit into a jacket pocket. Jacks for two microphones and two sets of headphones are provided to give two-way communication when needed. A connection for plugging into the plane's radio also enables both instructor and student to hear control tower directions while at the same time permitting communication with each other without any shift of the controls or connections.—AVIATION, *July, 1941*

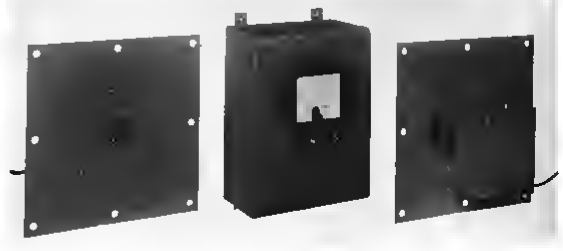
An outstanding improvement over older CF type furnaces, the new heavy duty Despatch furnace is said to be more adaptable to toolroom tempering and drawing, to the heat treatment of aluminum and magnesium alloy castings, and to general production work requiring a temperature range from 300 to 1,200 deg. F. Made by *Despatch Oven Co.*, Minneapolis, Minn., body construction is a great deal heavier, and heavy duty lift doors replace former swing type. Fan capacities have been increased and, with special heat distributing and air circulating ducts, horizontal airflow above and below each shelf is obtained.—AVIATION, *July, 1941.*

For high altitude flying by bombers, fighters and commercial transports, *AC Spark Plug Division* of General Motors, Flint, Mich., has developed a new type spark plug. The plug is new in design and material, and its ceramic insulator is next in hardness to the diamond. Made for the higher output engines, which have been developed for the large bombers flying great distances under heavy loads during the most severe weather, it functions efficiently under these conditions.—AVIATION, *July, 1941*

For installation in fuel vent lines, instrument pressure or vacuum lines, and de-icing equipment, *Kenyon Instrument Co., Inc.*, Huntington Station, Long Island, N. Y., has a check-relief valve which represents a departure of significance. As its designation implies, it combines features of both check and relief valves in fuel lines, etc., and affords distinct advantages wherever you are confronted with a problem involving fuel expansion, fuel tank purging, climbing, pressure fuel systems, testing and catapulting.—AVIATION, *July, 1941*

To drive alternating current generators operating aircraft radio, *Quality Electric Co.*, Los Angeles, Calif., make a 1½-hp. "Alternator-Drive Motor." Type D-A, Model B 107A. Used on bombers, the motor weighs 19 lb. and operates at 5,000 r.p.m. Company also builds a number of other electrical devices for the aircraft industry including d.c. motors for gun turret operation, bomb release switches, radio marker beacons, etc.—AVIATION, *July, 1941*

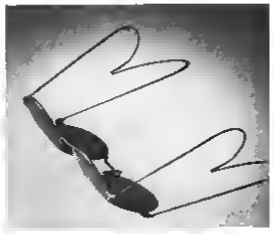
Where there is smoke, there is fire. Around this fundamental principle, *Warner Products Corp.*, Chicago, Ill., have designed a swift, automatic Air-Conditioning Smoke Alarm. Consisting of two mounting flanges—one for each side of an air duct—and a control cabinet located in a place accessible to the proper persons, the Alarm works photoelectrically. Mounting flanges are placed opposite each other, one containing light source, and the other the photo cell housing. When light beam is interrupted by smoke (10 percent by volume, or as predetermined), apparatus immediately functions by registering density of smoke on a meter on control cabinet panel and shutting off dampers and blowers. No "upkeep" is necessary except replacement of light bulb.—AVIATION, *July, 1941.*



Warner Smoke Alarm

Rapid Taper Hacksaw

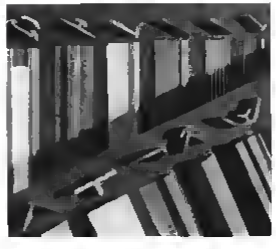
General Electric Thickness Gage



Fish-Schurman Neophen Goggles

A new hacksaw, with special advantages in aircraft construction, has just been introduced by *Rapid Mfg Co*, Glendale, Calif. Quickly convertible to a taper frame, this saw is particularly handy for work in tight corners or at any angle. New saw has an automatic tension lock, by which a cam action in the steel handle is said to lock the blade in place with a pull tension greater than any other frame. A guard prevents skinned knuckles resulting from contact with rough edges of sawed metal. Line includes 10- and 12-in. standard all-steel frames with tension lock, and 12- and 14-in. heavy duty saws.—AVIATION, *July, 1941*

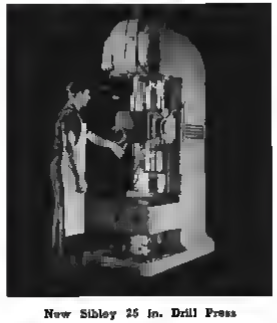
A new type of electric gage for measuring wall thicknesses of hollow aluminum propellers has been built by *General Electric Co*, Schenectady, N. Y. Instrument is also applicable to thickness measurement of any non-magnetic metal when only one side is accessible, even if the non-magnetic metal is backed up by a magnetic metal. Thicknesses up to 1½ in., depending on electrical sensitivity of metal, can be measured within an accuracy of 5 percent.—AVIATION, *July, 1941*



Werner Plastikmould & Plastiktrim

"Nose comfort", as well as eye strain prevention, is supplied by "Neophan" goggles made by *Fish-Schurman Corp.*, New York, N. Y., which are said to fully absorb the yellow rays emitted in welding, cutting or burning operations, especially in aluminum, without altering the rest of the colors in the spectrum. Elimination of the strong yellow sodium light actually enhances perception of other colors, and sketches or blueprints may easily be read without removing the goggles. Having optimum effectiveness at a thickness of only 2 mm., the lenses are light in weight, assuring maximum comfort, as the goggles do not press on the bridge of the nose.—AVIATION, *July, 1941*

Plastic products increasingly are entering into aircraft manufacture. A new line of extruded plastics, ohio and corrosive proof, flexible and light in weight, called "Plastikmould" and "Plastiktrim", have been announced by *R. D. Werner Co., Inc.*, New York, N. Y. They are made in a wide range of colors in similar shapes and sizes as now supplied in aluminum. Company also produces rods, tubes and other items both flexible and rigid, offering many possible applications in the lightplane and commercial transport fields.—AVIATION, *July, 1941*

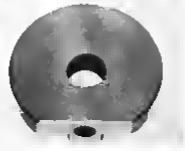


New Sibley 25 in. Drill Press

Precision accuracy and a rugged design have been built into the new 25 in. drill press made by *Sibley Machine & Foundry Corp.*, South Bend, Ind. Instant change of feeds and speeds are effected by cam operated levers within easy reach of operator. Spindle speeds range from 75 to 1500 r.p.m., and feeds from .005 to .045 in. The 6 splined spindle can be operated either by power or hand feed; the travel by power is 12 in., by hand, 12½ in. Transmission is a complete removable unit with transmission shafts mounted on anti-friction bearings. Multi-splined shafts are used throughout, and all gears operate in a bath of oil, providing a smooth, powerful drive. Tapping operations are controlled by electrical reversing switches, operating through a starting lever. Overall height of drill is 9 ft. 6 in. and working surface of table is 18½x24 in.—AVIATION, *July, 1941*

Lincoln Electric Arc Welder

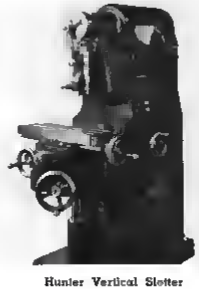
Pioneered for the national emergency, a new arc welding machine is announced by *The Lincoln Electric Co.*, Cleveland, Ohio. Most important feature is Lincoln's "dual continuous control" which permits independent adjustment of both welding current and voltage to obtain just the right type and intensity of welding arc. Adjustable in a continuous sequence of fine increments, the control avoids the compromise settings of conventional welding current controls. Delivering 10 amp. at the arc without extra attachments, unit is suited for welding the lighter gage aircraft steels and the welder's range also adapts it for heavy materials.—AVIATION, *July, 1941*



Keystone Porous Bronze Bearings

Bearings, molded to size and shape desired, are made by *Keystone Carbon Co.*, St Mary's, Pa. Seiflube porous bronze bearings are made from powdered alloys which are molded, then baked, and finally quenched in a good grade of oil. Oil reserve often lasts entire life of application. Because of their high strength, having a tensile strength of 35,000 lb p.s.i., these bearings will carry maximum loads without distorting or breaking. Low friction coefficient prevents excessive temperature, speed reduction, noise and scoring of shaft.—AVIATION, *July, 1941*

A variable speed vertical slotter designed for die shop, toolroom and repair shop operation is introduced by *Hunter Engineering Co.*, Riverside, Calif. Adaptable to a wide variety of machining operations, the Hunter Vertical Slotter has a work table provided with longitudinal T-slots, and is adjustable by hand feed in longitudinal and transverse directions and vertically. Maximum stroke of ram is 4½ in., and ram may be tilted either right or left through a 10 deg. angle for cutting tapered key-ways, etc. The positive acting clutch may be operated from either side of the machine, making it possible to stop the ram at any point. Machine is very compact, 63¾x38x48 in.—AVIATION, *July, 1941*



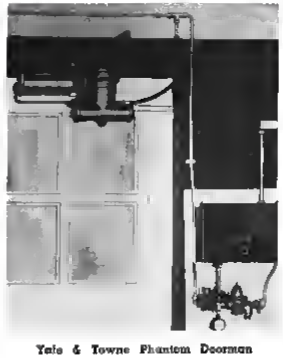
Hunter Vertical Slotter

Incorporating a Neoprene cushion permanently welded to the inside surface of the clamp, a new style tube clip has been announced by *Bendix Aviation, Ltd.*, Burbank, Calif. Available in sizes from ½ in. up, the new clip is called "Cushion-Clamp." Elimination of all Neoprene outside the clamp reduces by 60 percent the area exposed to combustion. Permanent bonding of Neoprene to the clamp prevents it from creeping or rolling out of place, eliminating assembly difficulties experienced heretofore and speeding up installation. Bonding process likewise prevents the Neoprene from extruding under pressure, the full cushion is preserved and the tube does not tend to become loose in the clamp. Permanent conductivity is also claimed for the Bendix "Cushion-Clamp" by riveting the bonding strip to the clamp with an integral upset eyelet.—AVIATION, *July, 1941*

Bendix Tube Clamp

A Phantom Doorman, designed for use on single-acting hinged doors, will conserve time and assist in maintaining efficiency in heating and air conditioning of aircraft plants. New unit, known as Type PH, and developed by *Yale & Towne Mfg. Co.*, Stamford, Conn., opens door by application of air pressure and closes it by spring pressure. Control equipment can be pushbutton, floor treadle switch, ceiling pull switch, bar type wall switch, or photoelectric.—AVIATION, *July, 1941.*

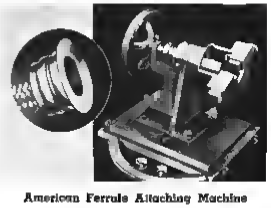
For grinding chip breaker grooves in carbide metal cutting tools, *The Drafto Co.*, Cochranton, Pa., announces production of the new Model A Drafto Chip Breaker Grinder. A vise of universal construction with dual locking feature is equipped with a ball adjustment to permit setting of the tool to any required angle. Stops may be set, locking the vise, but permitting tool to be removed for final inspection. Grinding is performed by diamond cutting wheel mounted directly on shaft of an electrically driven motor of ¼ hp. Horizontal motion of arm carries diamond wheel across face of tool, grooving the tip. Depth of cut is determined by turning knob set on motor hinge bracket which is graduated for micrometer adjustment.—AVIATION, *July, 1941.*



Yale & Towne Phantom Doorman

Simple to operate, a new bench type ferrule attaching machine, which will attach either straight or flared shank ferrules firmly and securely to flexible metal hose, is made by the *American Metal Hose Branch* of the American Brass Co., Waterbury, Conn. Machine may be used on applications for low tension radio shielding conduit, parachute rip cord housing, flexible fuel mixture indicator connections, and air and exhaust connections, all of which are manufactured by company. Fittings attached with American Ferrule Attaching Machine are said to adequately meet the "pull test" set by the Air Corps.—AVIATION, *July, 1941*

Drafto Chip Breaker Grinder



American Ferrule Attaching Machine

THE AVIATION NEWS

BLAINE STUBBLEFIELD, Washington — C. F. McReynolds, Pacific Coast — Jay P. AuWerter, New York — E. R. Lockin, New York

JULY 1941

U. S. Will Help Latins Oust Axis Air Lines
Congress Authorizes Subsidies Through RFC

Washington (AVIATION Bureau)—Twenty-two thousand miles of Axis-owned or dominated airways in South America are regarded by the United States Government as a foremost threat to the enforcement of the Monroe policy. Half-a-dozen federal agencies, including the State, War and Navy Departments, the Civil Aeronautics Authority, and the Federal Loan Agency are hot after the Nazis' Latin airlines, and are grounding them one by one.

Congress has just passed a law, signed by the President, which authorizes Reconstruction Finance Corporation to take emergency action anywhere—buy plants, operate them, sell them, accumulate strategic materials, make loans to foreign countries. And money almost without limit is provided for any or all of these purposes. Jesse Jones, Houston banker, friend of the President, Secretary of Commerce (as such, head man of CAA) and Administrator of the Federal Loan Agency, holds this vast authority.

Reading the law, you would never know it was aimed at the Axis in South America, but that is one of its several objectives. It provides money and, tacitly, the support of the U. S. Government, to uproot the Nazis aerial octopus that has a grip on that entire continent.

First, representatives of the United States cooperate with the Latin governments to rule them out. For that purpose we are lending money to those governments to buy new equipment for substitute lines, and we lend them pilots until they can train their own. Some are being brought here for training. Secondly, if these measures don't work, we finance competitive lines to put the Axis out of business.

On June 3 CAB amended the certificates of Pan American-Grace Airways, Inc., which authorize air transportation between the Canal Zone and numerous points in Bolivia and Brazil. The Board granted a quick exemption order, permitting immediate inauguration of the service pending this decision. Two Nazi airlines that had served these regions have been stopped by the governments concerned.

The President has cleared the way for priorities on equipment for the Latins. Planes are expected to come from Air Corps deliveries. W. A. M. Burden and William Barclay Harding, of Nelson Rockefeller's committee, are well along with administrative procedure. Thomas G. Herdin, member of the old Air Safety Board, is already in Bolivia.

RFC will not only finance equipment and training on terms outdoing Axis offers, but will also aid in development of airways and technical advice and will assist Pan American Airways in taking over some of the Axis-dominated routes.

Since the RFC law does not specifically mention Latin America, conceivably the government may use the authority in other quarters where hemisphere defense is involved, such as air cargo and passenger service to Greenland or other particularly strategic points.

Officials are meanwhile reluctant to discuss detailed plans, pleading military secrecy. Diplomatic negotiations are delicate in some instances and in others such tangles are arising as the case of private local operators who see in the new U. S. scheme a good chance to sell out the Axis—at a high-altitude price.

One year after the close of the World War, a group of German and Austrian pilots and ex-Army officers established an airline in Colombia—the first commercial airline in the Western hemisphere. Oswald Ryan, member of CAB, says this was the beginning of Axis penetration of South America. He says that the 22,000 miles of airways in S. A. is only 200 miles less than the total route-mileage of Pan American Airways and its affiliates in that continent.

International

BRITISH OVERSEAS AIRWAYS will fly three of these new Boeings from Baltimore to Europe on regular scheduled service. Only passengers will be official British personnel and those doing business with Britain.

Wide World

UNPLEASANT REMINDER is this scene at Inglewood as the troops moved in and the pickets moved out. The problem of strikes may be over, or it may continue to plague the industry.

General Johnson Officially OK's CPT Program
Need for Pilots Urgent; Training Women, Out

During recent months the Air Corps and the CAA have mended their differences over the CPT program and are now in practical agreement. This is due to a shift in the Air Corps training command, and to the efforts of Brig. Gen. Donald Connolly, a Corps of Engineers officer, and CAA's Administrator Brig. Gen. Davenport Johnson, now in charge of Air Corps training, has put the Army on record for the first time in direct approval of CPT. He says that without CPT it would be necessary for Air Corps to establish schools to train badly needed contract school instructors. His statement was made to a Congressional appropriations committee.

The demands of the aviation industry for trained pilots in past were largely supplied by the military, says General Johnson. The Army and Navy were glad that civil aviation could take their men on reserve status and keep them flying. But now it is no longer possible to release these pilots from military service, and "the CPT program must necessarily meet the demand," he says.

Approximately 22 percent of all those entering the Air Corps contract schools are graduates of CPT primary. Only 12 percent of CPT graduates are eliminated in Army's elementary schools as compared with 39 percent of run-of-the-mill men.

The Army likes the primary CPT course, because it weeds out misfits before they enter the contract and Air Corps schools. The Navy likes CPT secondary, because it has found it can skip them over its own primary and start them on its secondary or 33-hr. point. The Navy has comparatively few men, has its own schools, and can give men close supervision. The Army, because of numbers, is forced to farm out its training to contractors, and supervision is not so close.

Undoubtedly there will be some changes in the CPT setup. The Army might, for instance, use the CPT schools, with their college connections, for all ground school work, after the manner of the "Military Aeronautics Schools" of the World War. The secondary courses might be moved over to Army contract schools. But it no longer seems likely that the Army will "take over" CPT, as once feared, or that CPT's funds will be further curtailed.

Bad news for the women of CPT, 700 of whom have been admitted to the program, is that registration of any more has been prohibited at the request of the Army.

Never has there been a greater demand for professional services than there is now for airplane pilots. Army and Navy air arms need them to build up striking power for possible war. The Air Corps civil contract schools want 2,000 instructors. The airlines are even harder pressed for air crews than they are for airplanes. The British are crying for pilots to fly ferry bombers now piling up in this country. Canada wants student instructors. The South American countries need pilots to bolster their competition against subsidized Axis airlines. China wants pilots to beat off Japanese air raiders.

Wide World

YOU will probably see this Messerschmidt 109 in your town soon as it is to tour the country for Bundles for Britain. Pay your money and have a look!

NAA Declares Policies

No discordant notes interrupted the Louisville meetings of industry leaders and Federal aviation officials who discussed current questions with unusual frankness. The outcome was an unequivocal declaration of policy broadly affecting national issues even beyond the field of aviation—a 14 point program, unanimously adopted, including martial law to quell defense strikes and execution of convicted saboteurs, as well as many of the older and more familiar aviation aims, such as integrated airport program, all first class mail by air, and continuation of civilian pilot training.

A vote of confidence in NAA officers and management was unanimously passed in a meeting of the national council, the complete slate of NAA officers reelected for another year and four new board members added—Roger Wolfe Kahn, Wayne Parrish, Earle Johnson and I. S. "Stick" Randall.

Congress Gives CAA $94,977,750 for Airports
Total Fund $136,977,750 for 399 Projects

Washington (AVIATION Bureau).—Congress has added $94,977,750 to Civil Aeronautics Authority's fund for airport construction. This is a new high in awards for airports in any year, and is the result of a long campaign by CAA and others who believe that expansion of ground facilities is essential to defense. The Army has not been by any means unanimous in its approval of the expansion of civil airports.

Including the $42,000,000 of WPA allotment, estimated by CAA and Budget officials as necessary if the program is to be completed, total available fund is $136,977,750.

Last year, the first in which the CAA was given an airport improvement and construction assignment, a list of 250 airports was selected out of the "master" plan of 4000, previously prepared. For this work, $40,000,000 was appropriated, and the last portions of this sum are being allocated as the fiscal year draws to a close. Most of the construction jobs are approved, and many are under way, with only smaller contracts such as lighting, fencing and seeding yet to be awarded.

This year the CAA asked for $33,500,000 from which the Budget Committee cut $5,000,000. The House passed the Budget recommendation and the Senate then restored the $5,000,000. After this bill had passed the House, the President sent a request for $61,477,750 more for airports, naming 149 additional locations for improvements or new fields all to be constructed, as before, with an eye to the needs of the military forces during the emergency. This the Senate also approved. Thus, a 399 airport program, costing about $137,000,000 is in prospect.

The industry has the Defense Program to thank for this generous provision for airports. Thus far, the military have moved onto about a dozen civil fields such as those at Miami, Pendleton, Portland, Boise, Louisville, Albuquerque, Atlanta, and Savannah, sharing these with commercial operations until other arrangements can be made. The first CAA program includes new fields for military use only, such as at Louisville, and at Ft. Wayne, Ind., where a new mile-square field is now about 34 percent completed for use as a Group Headquarters, to relieve Selfridge Field at Mt. Clemens, Mich. In addition, the military has taken over many other commercial fields for use as training centers.

National Airport Opens
It's a Brave New World

Months late, and without fanfare, the Washington National Airport, called by CAA the world's finest, quietly began operating at 12 01 a.m., June 16. CAA officials, explaining the lack of ceremony, said this is a time for work and not for celebrations.

With John Groves, manager, cooperating, the airlines moved in and began rehearsing crews on up-to-the-minute baggage chutes, traffic control apparatus, communication facilities.

Operations began early in June when Penn-Central Eastern and American moved in. Company headquarters of Pennsylvania are being moved from Pittsburgh. Since then, hundreds of passengers have landed here amid construction litter on days when old Hoover Field was "under the weather".

Impressed by the experience at oil air terminals, and especially with the 1,400,000 visitors who paid a dime each last year to enter the spectators' promenade at LaGuardia Field, the designers of the Washington field have provided generously for visitors. Travelers and visitors are kept separated.

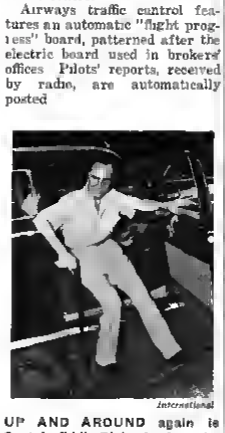
The loading area has all facilities such as fuel, battery cables, air conditioning hoses, telephone and pneumatic tube connections in pits grouped about each of the 14 loading stations; space is available for many more. Pits eliminate vehicles on the ramps.

Stop-and-go lights control traffic landing. Taxiing and taking off controls, developed by the Technical Development Section of the CAA, give safety, even without radio. At each runway-end are street-type red and green lights, an 80-ft. arrow in green neon and an 80-ft. cross in red neon.

A string of blue lights marks taxi routes, and where these cross runways, red and green lights control planes. Runways are bordered with white lights, with the last 1,500 ft. orange in color. The towerman can maneuver planes on the field and above. Automatic, submerged smoke pots indicate surface winds.

Control tower glass eliminates all reflection, and repels actinic sun rays which cause sunburn. A switchboard layout of the field is illuminated by "black light" shining on luminiscent paint. This is the nerve center of field traffic control.

Airways traffic control features an automatic "flight progress" board, patterned after the electric board used in brokers' offices. Pilots' reports, received by radio, are automatically posted.



International

UP AND AROUND again is Captain Eddie Rickenbacker who has spent the spring in an Atlanta hospital. We'll be seein' you!

SPOT CHECKING

Air Corps Ferry Command, organized under Col. Robert Olds, will pick up completed airplanes at factories and set them down ready for operation, at Atlantic Coast ports, to be flown or shipped to England. Air Corps is not flying the Atlantic itself but is about to take full responsibility for getting them started. The Ferry Command will use thousands of pilots and will be one of the important operations of the defense program.

Collier Trophy Committee for 1941: Grover Loening, Maj. Gen. George Brett, Jack Frye, Guy P. Gannett, Mrs. Betty Gillies, J. H. Kindleberger, Dr. Geo. Lewis, Leslie E. Neville, Stanley Wallbank, Gill Robb Wilson, and William R. Enyart as secretary.

Maine Airports and sites are being surveyed by Air Corps and WPA with a view to construction of four take-off fields for bombers to Britain.

Great Falls-Lethbridge extension of Western Air Lines closes the last gap in scheduled land-plane transport from Santiago, Chile, to Nome, Alaska, 11,250 miles.

Air Corps says it could put 12,000 air-borne troops in any Atlantic or Caribbean base in 48 hours.

Up to June 1, 7398 CPT graduates had volunteered for service in Army and Navy air arms.

Air Corps Board has been moved from Maxwell Field, Montgomery, Ala., to Elgin Field, Valparaiso, Florida. Valparaiso is redesignated Air Corps Proving Ground.

First city unit of Air Corps Cadets was Pittsburgh. At this writing 26 college units had been formed.

24,000 miles of teletype lines are being added to the CAA weather reporting system, bringing the total to 55,000 miles.

Airline Credit Corporation is the new agency set up under RFC to help Latin American countries get airline equipment and pilots to compete against and eliminate German and Italian lines there.

Caribbean Air Force is unified under command of Maj. Gen. Frank M. Andrews, including Panama, Puerto Rico and Trinidad, which have been separate commands. Striking power is greatly increased.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

More Pilots Than Planes

A notion of motorists, truck, tractor and taxi drivers, the United States finds little training necessary in manning its mechanized and armored forces. Russia, Germany, Japan, Italy, in fact most other countries, have few vehicles, few drivers. Germany raises all youngsters on aviation, as we do on motoring, and so has little air training trouble. Our objective from now on is to grow up in the air as we have on the roads.

Air Corps and CPT have discarded most of their differences to the great advantage of both. Much credit for this change is due Gen. Donald Connolly, CAA Administrator, and to Gen. Davenport Johnson, in charge of Air Corps training. The two got together, skipped all but public interests, worked out a plan.

The Army didn't mind, early in the defense push, turning nearly full production of tactical planes over to the British. But now that pilots are pouring out of the training mill, some have nothing to fly. That's bad for their morale, and the high command is somewhat irked to see the planes going overseas. Not that they want to or can do anything about it. These "graduate" military pilots are not fitted for most of the commercial jobs that are crying for stick men, and anyway, the services are not letting go of their airmen any more.

Question of a separate air command persists in Congress, where appeals to the reasoning of Gen. Billy Mitchell, Alexander de Seversky, and Al Williams, et al, reach a high crescendo. Several bills have been introduced. Creditable persons, in and out of service, are working quietly for it. One of them, a former air force commander, recently attempted an appeal to the British Government to use its influence toward separation of our air power. This is a hard proposition to guess about. No Army official is going to speak out. Only the President, or an overwhelming bloc in Congress, could jar the issue loose. Don't bet either way.

"Lech" and "Hermes," two German freighters that crashed the blockade into South America, brought airplanes and parts for an important Nazi-dominated Latin airline. The airline sent out observation planes which guided the ships through.

The Stubblefield Award goes to U. S. Air Corps officers who require air reserve officers, as part of their examination for promotion, to solve problems in troop movements at the Battle of Gettysburg.

Frank Gannett, publisher, came out of the President's round-up of two engined planes for Britain still in possession of his Lockheed.

Invasion of Crete by aircraft was no particular credit to the planes, say the "old boys" of Army and Navy; the planes merely served as transportation.

A snag at Bolling Field was a first class airplane mechanic before he was drafted. You keep hearing complaints about the Army putting skilled people in non-strategic jobs. The Air Corps says it would take too much time to avoid these few mistakes. Critics say: Why aren't local draft boards so organized as to do it?

Airport Zoning Law

Investigation of airline accidents by the Nichols Committee of the House of Representatives is developing new interest in uniform airport zoning and air traffic control. Zoning means control of surrounding obstructions.

Announcing that his committee is making legislative recommendations along these lines, Rep Nichols (D, Okla) is asking State and local governments to postpone aviation laws until Congress has acted.

CAA has drafted two model laws on airport zoning—one for States and one for municipalities—designed to leave the problem in local hands but at the same time to achieve uniformity of standards. As yet, CAA has no authority to regulate structures on private land surrounding airports, other than through unofficial negotiation or advice to local governments.

Fun at Birmingham

Steadham Acker put on his best air show to date in Birmingham last month. There were more people, more airplanes and more fun for everyone than ever before. The two-day show brought hundreds of thousands to the Birmingham airport. The large crowd was handled smoothly and efficiently. Acker continues to hold his title as best air showman in the U. S.

Board of Governors of the Aero Club passed a resolution to urge Congress to establish a separate air force. A committee was set up to promote this idea and much enthusiasm was shown for the plan.

Eyes on Elmira

The Twelfth Annual Soaring Contest (June 26-July 13) takes on special significance. "Crete" will be the thought in most minds. Senator McCarran has offered a bill to foster gliding, and companion bills in the House are offered by Congressmen Cole and Fish.

Jay Buxton, California pilot, is operations manager; R. E. Franklin, Gustav Scheurer, and John Nowak, head timers. John Robinson, 1940 National Soaring Champion, and Chet Decker, last year's runner-up are again contestants, Robinson flying a Ross Stephens and Decker a Minimoa. The Warren E. Eaton Memorial Trophy, the Bendix Distance Awards, the Edward S. Evans Championship Trophy, and AVIATION Magazine's Award for Outstanding Sailplane Design are up for competition, along with several other prizes and a number of new ones.

Coming Events

July 1–5 National Competition Model Meet, sponsored by Chicago Times and Chicago Park District, Chicago Ill

July 4–5 2nd Annual Air Show and Private Pilots Air Meet Crowner Field Wellsville N Y

July 4–6 22d Annual National Meeting, Albuquerque N. M.

July 18–19 Denver Air Show, Denver Col.

Aug 17–18 Sheldon Air Show Sheldon Aeronautics Club Sheldon Iowa.

Aug 22–Sept 2 3rd Annual American Open Soaring Contest, Joliet Ill.

Aug 29–31 Aero Medical Association, 12th Annual Meeting Boston Mass

Sept 17–19 National Petroleum Association, 39th Annual Meeting Hotel Traymore Atlantic City N J

Oct 2–4 National Association of State Aviation Officials, Annual Convention Providence R. I

Oct 30–Nov 1 SAE National Aircraft Production Meeting, Biltmore Hotel Los Angeles, Calif

CALLING NAMES

Capt. Robert M. Losey, Air Corps officer killed during an air raid in Norway is honored through naming of the airport at Ponce Puerto Rico "Losey Field"

John B. Walker, assistant to president of United Air Lines, is elected president of the Aero Club of New York, which is the Greater New York chapter of NAA

"Duke" Andrew Reid goes to Brewster Aeronautical at Newark as inspector in final assembly department

Major Gen. James E Chaney, commander of First Air Force at Mitchel Field, is in London as observer

Bryon W. Ogle is appointed district traffic manager for Braniff Airways at Amarillo, succeeding **Ben E Schomburg,** called to military service

Don. I. Carroll supervises new unit known as the Manufacturing Research Department of Vultee

E. R. Stettinius, Jr., William L Batt, R C Bateman, and **H J. Symington** form the Material Coordinating Committee for the United States and Canada to enable this country and Canada to cooperate in exchanging information on their supplies of raw materials for defense according to announcement of Director General Knudsen of OPM

J Mason Hoagland William G. McDuffie and **Henry Balsell Wilson** have been elected directors of Vultee Aircraft, Inc

Ruth Nichols, holder of three maximum international records for women, receives citation of honor from General Federation of Women's Clubs as one of America's 53 most noted women pioneers. She is now active in organizing Relief Wings dedicated to humanitarian service by air

Lawrence W. Scudder, in 1928 organizer and president of Interstate Air Lines president of Century Metalcraft Corp , and an Air Corps captain in the World War died at his home on May 17

Charles Bay, U S aeronautical engineer is appointed chief of production of the aircraft division of the Canadian munitions and supply department assisting **E P Bell,** director general of aircraft **Clifford Saeger** becomes manager of Penn Central's passenger service department

James L O'Neill is appointed Deputy Director of the Division of Priorities of OPM succeeding **Emil Schram**

Albert Leon is appointed manager of the export department of Reynolds Metals and **Robert W Speir, Jr** is named assistant export manager. Both are members of the Reynolds organization

A E Blomquist, Eastern Air Lines airport engineer is author of Outline of Air Transport Practice just off the press

Ralph S Damon, president of Republic Aviation receives degree of Doctor of Engineering from Clarkson College of Technology, Potsdam, N Y, **A. V Davis,** board chairman of Aluminum Co receives Doctor of Science degree

Ralph Shearer, Lloyd Frederick, Chester Inman and **Paul Ulman** are winners of United Air Lines scholarships entitling them to courses at Boeing School of Aeronautics

Joel Whitney, technical training supervisor at Ryan's Air Corps schools at San Diego and Hemet is advanced to registrar of Ryan School of Aeronautics

Robert W McDonald, in charge of Detroit-Buffalo airway for American Airlines since 1933 is now station manager for the line at Toronto

George T Kilmon and **Edward M Martin** are elected respectively assistant secretary and assistant treasurer of B. F. Goodrich Co

A. E Ulmann, president of Dowty Equipment Corp, returns from a quick trip to England to visit the parent company. Dowty Equipment, Ltd.

Gilbert Colgate, pres. of Colgate-Larsen Aircraft and chairman of Air Associates is elected a vice president of Aeronautical Securities Incorporated to succeed **A. P. Taliaferro,** resigned

Lloyd L Lee, formerly with Willcox-Rich is now vice president of Gordon R-Co in charge of sales and engineering

Lt. Commander J.D.P Hodapp, U S N retired is elected a director of Luscombe Airplane Corp

William L Batt, SKF president and chief aide of **John D. Biggers,** OPM, is appointed an employer member of the Federal Committee on Apprenticeship replacing **Ralph E Flanders,** Jones & Lamson president

Henri Stakgold president of American Aircraft Co and of Cornelius-ern & Stakgold, is on 3-months' tour of Latin American markets, where he will organize branch offices.

George W Borg resigns as chairman of Borg-Warner Corp. retaining presidency of Borg & Beck Division and his directorship of Pump Engineering Service Corp. His former post of chairman has been discontinued but responsibilities are taken over by **C S Davis** Borg Warner president

Brig Gen. Henry W Harms is ordered to the Office of the Chief of Staff in Washington

Maj Gen. H H Arnold is made Doctor of Science by University of Southern California.

E J Hergenroether resigns from Development and Research Division of International Nickel to join staff of Conservation Section Production Division OPM

H D McKnealy former pilot and mechanic for Arthur Knoder Inc becomes East Coast representative for Lockheed

L. W Babcock formerly with TWA is president of new "Fly Their Inc" formed to manage Hampton Airport Bridgehampton L I

Cyril C Thompson, United's vice president is elected to NAA's board of directors

Richard M McGrath is president and Glenn Banfield vice president of the new Aero Club of Elmira affiliate of NAA

The Ninety-Nines, women flyers' group will hold annual meeting in Albuquerque New Mexico July 4 5 and 6, it is announced by Mrs Betty H Gillies, president of the association

Raymond Loewy, Industrial Designer, is responsible for the interior design of Lockheed's 67-passenger transport. Previous work includes Douglas DC3 and the Boeing Stratoliner, Curtiss Wright "20", Fairchild and Stinson planes

Ernest W Robischon loans over his aviation library of 1,000 books and 7,000 magazines to the public Glendale area students and aircraft plant employees

Howard B Ingalls, onetime superintendent of maintenance for American Airlines and winner of **Aviation's** Maintenance Award in 1938, is appointed as superintendent of maintenance, Northeast Airlines

Major Ralph W Page is elected president of American Association of Airport Executives. Major Page is manager of Lambert-St Louis airport and president of NAA Chapter in St. Louis.

Harry R Playford is president of new St Petersburg NAA Chapter with 75 members

Hon. John E Ranking, U S Congress, says airplane range will reach 25,000 miles in five years and aviation will have taken over most tasks of the Navy

J. A. Boettner, chief pilot Goodyear Airship Reliance would up the ship's 12th season in Florida with return to Akron

E D Spicer of General Electric is advanced to assistant to the vice president in charge of manufacturing **J M. Bowell** succeeds him as works manager

J. L. McKnight, assistant secretary and head of the legal department of B F Goodrich Co passed away on May 15.

Normal L Beakle is made manager of sales of Copperweld Steel Co

B A Broughton and **James O Clawson** join Meldrum & Fewsmith agency and are assigned to Republic Steel account.

A W Parker retires from Worthington Pump & Machinery after 51 years of continuous service. R M Cleveland is made manager of the Boston office

Edward S. Sievers is Weston Electrical Instrument representative at Los Angeles and **John D Farnsman** is associated with him

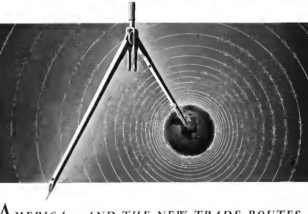
Hollis Gordon and **Chester Glover,** agents respectively for National Branch & Machine Co and Consolidated Arithmetic Machine Co, open sales offices at 303 W Washington Boulevard, Chicago

Melvin C. Harris is made district manager of all the Pittsburgh area plants of Allegheny Ludlum Steel **Carl B Pollock** succeeds him as manager of the Brackenbridge plant **George W. Evans** becomes general superintendent of the Brackenbridge plant. **Stanley A. McCaskry** is elected assistant secretary

William J Hawley is made sales engineer of Kent Owens Machine Co

M. R. Dill is elected a director of Lincoln Electric Co , **J C Lincoln** board chairman. **J. F. Lincoln,** president.

Jesse J. Ricks and **Benjamin O'Shea** are elected respectively board chairman and president of Union Carbide & Carbon Corp



Glider Advocates Cite Nazi Invasion of Crete But Army Believes Parachute Troops Better

The Army's answer to AVIATION'S inquiry as to its negative stand on gliders is simple. It thinks better results can be obtained with parachute troops. No details are given, but this is the reasoning you can assume: If a sail train including tow plane, will carry 70 men, the Air Corps reasons that a troop plane alone to carry the same number wouldn't cost much more time and money, it could deliver troops at the objective quicker, and the plane would be saved, whereas most of the gliders would be lost by crash or enemy destruction.

It is admitted that gliders have the advantage of quiet approach and that they can land troops and their equipment concentrated and ready for action. But the British say any glider invasion of their island will meet with disaster.

Air Corps has not dismissed glider strategy by any means. It has two officers at Elmira and two at Joliet, working on development. While there is not in this country now any glider that can carry more than two men, the manufacturers are working up designs for the Army to carry 10 or 15 men, for further experimentation. In fact, congressional committee hearing records show that Air Corps is buying 30 gliders, type not revealed. Also a few Air Corps pilots have been assigned to glider training.

Germany is reported to have 50 glider factories and 25 glider schools. Estimates of Nazi glider pilots vary between 100,000 and 1,000,000. The U. S. has less than half-dozen factories and only 109 certificated glider pilots and 208 gliders, only 33 of which are certificated. Soaring is done in only a few places in the country.

Flight Strips Wanted

Federal construction of emergency one-runway landing fields alongside the highways is in the offing. They would be built by Public Roads Administration through the state highway departments. This development, which bothers CAA a little, is seen by some as an entering wedge for transfer of airfield construction to highway organizations.

Plan is to build fields 300 to 800 ft. wide and 2,000 to 8,000 ft. long beside straight stretches of road which run in the prevailing wind direction. The road itself would not be used for a runway, but economics would be achieved by building and maintaining the field at the same time as the road. No lights, buildings, or other equipment would be provided.

Army would like to see about 400 of these little fields built at about $50,000 each. Some 150 would be in New England and the Appalachian area, 100 in the Pacific Northwest, and the rest scattered.

Fields would not be used for regular operations but to permit massing military ships in critical areas and to help in ferrying planes from factories to Canada.

Enlisted Men Will Fly We Train British Pilots

The War Department is not only undertaking a program to train enlisted men as pilots, under new Congressional authorization to form a group of non commissioned officers in the Air Corps, but is also beginning an aid-to-Britain project to train 5,000 British as combat flyers.

Concurrently, the Army is stepping up its regular flying cadet program from 12,000 to 30,000 pilots annually, and creating the grade of aviation cadet, putting Army flying cadets on the same pay and allowance basis as those of the Navy and Marine Corps.

The first contingent of 550 British flyers arrived last month to begin a 30-weeks course, to be followed by like groups every five weeks. About 3000 will receive primary and basic training in civilian schools, 4000 primary training in civilian schools, and advanced training in Army Air Corps Training Centers.

Numerous colleges and universities meanwhile announced organization of flying cadet units composed of 20 men each from the same campus.

Appointment in Hawaii

"Just a routine flight" is the way Lieut. Gen. Delos G. Emmons, commanding GHQ Air Forces, described the mass flight of 21 B-17-D Flying Fortress bombers from Hamilton Field San Francisco, to Hickham Field, Hawaii, 2,400 miles, in one minute less than 14 hr.

On the Hawaii flight each ship carried two navigators and flew independently, not in formation, to give "training for these navigators."

The whole flight was above fog that blanketed the Pacific and the skill of the navigators was demonstrated by the fact that each ship arrived almost exactly on schedule. Lieut. Col. Gene Eubank was in command.

3,000 Barrage Balloons

Congress has appropriated $45,000,000 for about 3,000 barrage balloons and $7,000,000 for a balloon training school. Some of these balloons might go to Britain, since there is no apparent need for them in this country. But some outlying U. S. bases, such as Hawaii, the Philippines, Puerto Rico, Greenland, and others probably would be attacked by air if we should enter a war. Barrage balloons are a strong deterrent to dive bombers, and they hold high bombers higher.

FLOYD BENNETT FIELD is now U. S. Naval Air Station at New York since the Navy took complete possession of the field. National Defense flies on, but commercial operators were not able to find new homes.

Wright Field Pressure Chamber Contract Let

Contract has been awarded for construction of a supplementary pressure chamber at the Wright Field Aero Medical Laboratory. It will be a low-pressure, low-temperature chamber of steel, 7½ ft. in diameter and 20 ft. long, and will combine both air-evacuation and refrigeration elements.

Underground Hangars

Underground hangars at offshore military air bases have been adopted by the Army.

No effort will be made, however, to include continental air stations in the new program, witnesses said, indicating that the cost outweighs probable advantages.

Pay for Parachuters

Parachute troops will henceforth receive $100 a month additional pay for officers and warrant officers, $50 a month extra for enlisted men of both Army, Navy and Marine Corps.

Plane Borne Tanks

Some Army officers have been talking in Congress about tank-carrying planes. Reports are that the Germans brought 5 to 7 ton tanks, half the size of "light" tanks, to Crete in planes, probably in parts, designed for quick assembly. Officers told Congress plane-borne tanks would be valuable in the Western hemisphere, because we have such distances to reach points of possible attack.

Control Tower Control

As this was written the Army was seriously considering taking over a large number of control towers at civil airports, especially those occupied by the Air Corps. The control tower is operated by the municipality that owns the airport. When the Army puts its own man in, that makes two, which is too many.

Three Firms Join to Build Boeings

Bombers Put Ahead of Other Work

Washington (AVIATION Bureau) — The "500-a-month" heavy bomber program is not simply to be superimposed on the existing aircraft schedules as was done in the Detroit bomber program. Instead it is actually to displace some existing projects. Thus, where it had originally appeared that production under the new plans would come early in 1943, it now looks as if there may be substantial expansion of heavy equipment output as early as a year from now.

Two nearly completed plants intended for production of light bombers and military transports are instead to be diverted to assembly of four engine bombers. Moreover, priority ratings two steps higher than those attached to the rest of the aircraft program, are being given to the bomber orders. This means that tools and equipment intended for other plane plants can be grabbed for the new bomber program.

A second new feature of the program is assignment for the first time of final assembly of aircraft to auto manufacturers. Ford is now to build Consolidated B-24s complete. In this case also a plant is ready. Ford's new Ypsilanti plant was built primarily for manufacture of parts and sub-assemblies for B-24s to be assembled at Tulsa and Fort Worth. However, it was built oversize to permit final assembly operations. Ford has been anxious to build complete planes for some time (ever since he was offering to build a thousand a day), the War Department until now has been rather discouraging him, but he's finally won out.

It is reported that other auto manufacturers may be asked to go to final assembly.

Since last summer there has been a steadily increasing emphasis on heavy bombers. The aircraft schedules set up at that time called for a capacity to be achieved by July 1942 of 65-85 four-engine ships a month —about two thirds Boeings and the rest Consolidateds. Production under these schedules has now reached some 30 a month.

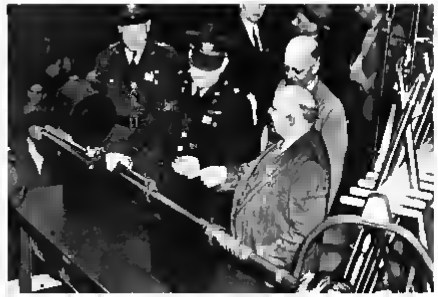
Last fall plans were made to step up production of Consolidated bombers by 100 a month, effective the spring of 1942. Government owned assembly plants at Tulsa and Ft. Worth were to be operated by Consolidated and Douglas, and parts and sub-assemblies were to be furnished by Ford from a new plant to be built at Ypsilanti, Mich. These three plants are now under construction, and this month contracts were placed for bombers to be built in the plants. Small scale production is expected to start late this year.

Current expansion would provide capacity for some 300 additional heavy bombers a month —largely Boeings. Ford is to manufacture an unspecified number of Consolidateds in his Ypsilanti plant. The Boeings are to be assembled by the Boeing firm itself, Douglas, and Lockheed. Boeing will build a $17,500,000 government-financed plant of 1,320,000 sq.ft. at Wichita, where its Stearman division is already manufacturing trainers and bomber parts. This is the only new plant yet announced.

Douglas will use its nearly completed Long Beach plant for its share of the assembly job. This plant was intended for the manufacture of Douglas' A-20 A light attack bomber and military transports. Lockheed will use its new Vega plant at Burbank, Calif., which was to have been used starting this month for manufacture of the Vega-Vanture—a medium bomber for the British.

Operations of the three firms building Boeings will be coordinated through a newly formed committee representing the companies, the Army, and OPM. Purchase of parts and sub-assemblies for all the Boeings will be coordinated through this committee. Operations of the airplane companies will largely be restricted to assembly. Source of parts has not yet all been revealed. But it is known that original plans for Long Beach operations contemplated extensive use of auto body firms, particularly Briggs, and some of these arrangements will likely be switched over to the bomber work. It is known that Bell and Curtiss are to supply sub-assemblies.

How much production is involved in the plants so far announced is not known, though it is understood to be in the neighborhood of 150-200 a month. This would leave sources still to be found for 100 to 150 bombers a month. Also still to be worked out as we go to press, is the contemplated expansion of the medium bomber program.



BENDIX AVIATION now builds the first 20 mm. aircraft cannon to be produced in this country, at its Eclipse Machine Division. First cannon is shown above. L. to r.: Brig. Gen. A. G. Gillespie, Brig. Gen. C. T. Harris, Jr., and W. L. McGrath, head of Eclipse.

PRATT & WHITNEY AIRCRAFT has installed three of these 5-ton electric cranes in its packing and shipping department at Hartford. Bill Willgoss, left, superintendent, starts the crane with Daniel Jack, Ass't. Factory Mgr.

New Wave Coming

Of Plant Expansion

A new series of plant expansion announcements is to be expected soon. Some $1,500,000,000 of appropriations are available (and, as we go to press, still unallocated) for munitions plants of all kinds, including a substantial quota of aircraft facilities. In addition, the RFC has earmarked $350,000,000, at the request of OPM, for plant expansion involved in the new accelerated bomber program. This of course will involve new facilities for engines, propellers, guns and a multitude of accessories as well as airplanes themselves. First announcement under the new program is Boeing's $17,500,000 plant at Wichita, whose 1,320,600 sq.ft. will be devoted to assembly of B-17s.

Included among recent expansion plans are the following:

Grouse has been broken for a second large aircraft parts building at Goodyear's Akron airport. Financed by Goodyear Aircraft Corp., it provides 85,000 sq.ft. of floor space. Completion of the plant, which represents an investment of $400,000, is expected by late summer.

RFC authorized an additional loan of $446,510 to Beech Aircraft Corp., to be used in the construction of facilities at Wichita.

Including equipment, a total of $1,478,800 will be spent on the latest expansion of the Ranger factory at Farmingdale, L.I. The one and two-story building of brick and steel provides space for manufacture of engines and includes enlargement of present offices.

An aircraft starter plant by Jack & Heintz, Inc., Cleveland, costing $1,293,121, has been approved by the Defense Plant Corp. It will have 65,500 sq ft of floor space and will be near the present facilities of the company in Cleveland.

Curtiss-Wright Corp. is awarded a contract of $4,503,494 for additional machinery, equipment and construction, at its Columbus, O., St. Louis, Mo., and Buffalo, N. Y., plants.

A $2,172,000 contract for new facilities, with $102,000 for rehabilitation of a building and $2,070,000 for equipment to be used in the manufacture of aluminum forgings, was awarded to Willys-Overland Motors.

Defense Plant Corp's $1,108,001 contract with Pullman Standard Car Mfg. Co., Chicago, will provide facilities for the manufacture of outer wing assemblies and spare parts for Douglas.

Chrysler Corp., Detroit, has entered into an agreement providing for facilities, costing $1,691,200, to be used in the manufacture of military aircraft parts. The new plant will manufacture parts for the B-26 which Martin will assemble.

Air Corps Pilots Fill Ferry Shortage

The Air Corps has assigned its pilots to the job of ferrying fighter planes intended for the British into Canada for delivery abroad. An incidental advantage is provision of flying time in heavy combat equipment, but principally it will relieve a shortage of British ferry pilots that has been becoming serious as the volume of production increases. Early last month some 200 Lockheed Hudsons—about two months' production—were being held in this country awaiting delivery.

The Air Corps ferry service has been organized into a special Ferry Command under Col. Robert Olds, attached to the Chief of the Air Corps. Two schools are to be established in which junior pilots can be given training in multi-engine equipment preparatory to ferry duty.

ONCE A COW PASTURE, now producing aluminum at the rate of 30,000,000 lb. annually. One of five units, this new plant will bring production of Aluminum Co. of America to over 150,000,000 lb a year.

Administration Hits At Work Stoppages

Washington (AVIATION Bureau)—The long expected administration blitzkreig against strikes in defense industries was precipitated by the North American strike. Within a couple of days, soldiers broke the strike, the House inserted into an appropriation bill penalties against strikes or picketing following mediation board proceedings, and draft boards were told to reclassify strikers.

Common element in these administration sponsored moves was strengthening of the mediation board virtual transformation of it into a compulsory arbitration panel. This implied a firm determination to keep work going, but it did not indicate any immediate intention to freeze wages or union status.

Ultimate freezing of wages is not ruled out in the administration, but first, Washington feels, labor is entitled to "one bite" of defense earnings. This was made inevitable when the wage increase in steel went through, and a more or less standard 10 cent increase seems to have become the mediation formula.

New Leather Packings

New development in leather packing material designed particularly for aircraft use is announced by E. F. Houghton & Co., Philadelphia, Pa. Although exceptionally soft in texture, this packing is unaffected by oil of any kind. Made to withstand pressure ranges from zero to 3000 lb. per sq in., it will also withstand over 200 deg heat and hold a perfect seal down to minus 50 deg. F.

Used in airplane controls, shock struts, retractable landing gears, bomb doors, etc., their high tensile strength is said to meet all specifications.

Aluminum Production Upped

With the throwing of an electric switch at Vancouver, Wash., capacity of more than 150,000,000 lb annually was added recently to the works of Aluminum Co. of America.

Construction of the new plant is part of a $200,000,000 expansion program which, when completed in midsummer 1942, will enable Alcoa to more than double its peak peacetime output of 1939, when more than 327,000,000 lb of aluminum were made.

The Vancouver works is one of five aluminum-producing plants of the company each producing 30,000,000 lb a year. In addition to these, Alcoa has 12 other plants where the metal is processed.

ASSEMBLY LINES

By Robert Colborn

May production of military aircraft dropped disappointingly below April figures and June output is unlikely to be much better. The May figure of 1,334 aircraft is 50 below April instead of 100 above as had been hoped. Strikes had little effect in May, except perhaps the Harvill Die Casting shutdown. But in June the effect of the North American, Alcoa, and Bohn Aluminum stoppages will show in the totals. Low May deliveries apparently means that engine and propeller output has been unable to keep the pace set by the airframe plants in the preceding couple of months. Substantial glider lines were built up at several plants. Another factor was a model change at Lockheed, where production of Hudsons, which had been running about 90 a month, was finished and manufacture of the improved Ventura started.

First of the new propeller suppliers being developed by OPM is Nash Kelvinator, which is to make Hamilton-Standard propellers under license in a building bought from Reo at Lansing and equipped by RFC's Defense Plant Corp. at a cost of $8,434,000. As reported last month, OPM is considering several arrangements of this character, duplicating the device by which additional sources have been developed for P & W and Wright engines.

Allison engine has taken another step up in power with completion of Army acceptance tests on a new model developing 1,325 hp. with no change in weight. This is the second recent step-up. The first production model, the C, manufacture of which was completed a month or so ago, developed 1,090 hp. The later E and F models, now in production, boosted this to 1,150 hp. and slightly reduced the weight. The improved engine, reportedly is to be used in Curtiss new pursuit, successor to the P-40. Prototype of this job, the XP-46, is in the air.

Powered conveyor assembly line, said to be the first in the industry, is credited by Vultee with halving final assembly time at the California plant and cutting floor space requirement by a third. Some 6,250 ft. of monorail conveyor serve final assembly for basic trainers and fuselage, center section, outer wing, and tail subassembly lines as well as the engine-mounting gallery. Final assembly line has 46 stations.

Consolidated delivered about 70 patrol bombers in April to Navy and British (50-50), nearly doubling March output and more than tripling January production.

An inspection service to check on fire and other industrial hazards in defense plants is being organized by War Department. Civil Service is gathering a staff from insurance and industrial engineering fields. Prime responsibility rests on company management, but the new service will offer supervision and advice.

Price of plywood is under pressure from Washington. Price czar Henderson demands a 7 percent cut on threat of imposing a price ceiling.

Plywood, using the new plastic adhesives, is rapidly becoming a major material for civil plane builders, as a substitute for strategic metals. A limited amount of aluminum has been allotted for CPTP production, but manufacturers who now exceed the per plane allotment, or who don't build for CPTP face a serious problem. And even those who use smaller amounts are trying to reduce the poundage, on the conservative assumption that aluminum supply will get worse before it gets better.

Piper, for instance, well within the 195 lb. allotment for Class 1 planes, is investigating the use of plywood for cowling, leading edge of wing, and possibly even for the firewall.

Rose Aircraft, in cooperation with Piper, is working on the development of an all-plywood plane of skin-stress design. This ship, still in the experimental stage, is intended to be aerodynamically radical also, using large slots and flaps to limit terminal velocity, with flaps down, to 50 or so m.p.h.—making it possible to dive into a landing.

Floats of plastic-bonded plywood, for light planes, have been OK'd by CAA and are being manufactured, in the Wollam design, by National Trailer of Elwood, Ind. They are expected to be several hundred dollars cheaper than aluminum floats.

Skyfarer, General Aircraft's new spinproof job, is also being redesigned for plastic, since inventories on hand only cover about 65 ships.

Air Corps, likewise, is studying the possibility of reducing the aluminum content of its trainers. Chief attention so far has been directed to plywood and stainless steel. Meanwhile, the possibility exists of at least temporary shortages of plastic bonding material for plywood. There has been heavy pressure on manufacturers of almost every sort of thing to try plastics as a substitute for strategic materials and the industry is beginning to feel the strain. To make matters worse, some of the underlying chemicals needed for the phenolic resin plastics also go into other defense items.

Military application of light planes is being taken quite seriously by the industry. Manufacturers are actively pushing the value of Class I craft for liaison and spotting work, arguing low cost, quick deliveries, ability to land anywhere, ready availability of pilots. Air Corps is cold to the idea, but some interest has been shown by artillery, armored force, and other non-flying services.

More imaginative in the industry talk of mounting light machine guns, carrying small bombs, even of hanging a few hundred feet of wire underneath in a sort of winged balloon barrage to tangle the enemy flyers. They sneer at half-million dollar bombers and mutter about clouds of mosquitos.

Production of light planes could be stepped up overnight, it's argued, to 2,000 a month and skyrocket from there.

Aeronca Aircraft Corp. is new name of Aeronautical Corp. of America, intended to identify the company with its plane. Aeronca has expanded its Middletown plant to boost capacity from 150 to 240 planes a month, is planning next year to add a four-place job to its line.

Recent Awards

War Department

Switlik Parachute & Equipment Co., Trenton, N. J., $157,300 for parachute assemblies.
Air Associates Inc., Bendix, N. J., $142,825 for aircraft mooring kits.
The Leece-Neville Co., Cleveland, Ohio, $220,000 for assemblies.
General Motors Corp., Anderson, Ind., $493,900 for assemblies.
Curtiss-Wright Corp., Robertson, Mo., $151,477 for airplanes.
Consolidated Aircraft Corp., San Diego, Calif., $226,636,200 for heavy bombers and parts.
Boeing Aircraft Co., Seattle, Wash., $95,242,896 for heavy bombers and parts.
Chrysler Corp., Detroit, Mich., $5,336,835 for airframe nose and center fuselage section.
Bendix Aviation Corp., South Bend, Ind., $1,344,935 for carburetor assemblies.
Curtiss-Wright Corp., Buffalo, N. Y., $1,598,180 for maintenance parts for planes.
Bendix Aviation Corp., Bendix, N. J., $1,131,700 for starter switch and solenoids.
Wright Aeronautical Corp., Paterson, N. J., $514,755 for maintenance parts for engines.
Curtiss-Wright Corp., Robertson, Mo., $31,904,388 for airplanes and parts.
Lockheed Aircraft Corp., Burbank, Calif., $47,769,196 for airplanes and parts.
Fairchild Engine & Airplane Corp., Long Island, N. Y., $954,667 for engines and parts.
Sperry Gyroscope Co., Brooklyn, N. Y., $599,183 for controls manual assy valves etc.
Pump Engineering Service Corp., Cleveland, Ohio, $523,693 for pump assemblies.
Hudson Motor Car Co., Detroit, Mich., $921,719 for airframe parts.
Bendix Aviation Corp., Bendix, N. J., $108,141 for pump assemblies.
Vickers Inc., Detroit, Mich., $322,344 for pump assemblies.
Boeing Aircraft Co., Wichita, Kas., $154,976 for maintenance parts.
Consolidated Aircraft Corp., San Diego, Calif., $163,640,000 for bombers.
Douglas Aircraft Co., Inc., Santa Monica, Calif., $158,850,000 for bombers.
Continental Motors Corp., Muskegon, Mich., $5,241,746 for engines and spare parts.
Wright Aeronautical Corp., Paterson, N. J., $1,112,190 for engines and spare parts.
Beech Aircraft Corp., Wichita, Kas., $[illegible]171,000 for airplanes and spare parts.
Vultee Aircraft, Inc., Downey, Calif., $[illegible]917,990 for airplanes and spare parts.
Curtiss-Wright Corp., Buffalo, N. Y., $[illegible]444,414 for airplanes and spare parts.
Fairchild Engine & Airplane Corp., Hagerstown, Md., $4,746,451 for airplanes and spare parts.
Ryan Aeronautical Co., San Diego, Calif., $4,134,205 for airplanes and spare parts.

Navy Department

Kilgore Mfg. Co., Tipp City, Ohio, $1[illegible]666 for aircraft engine cartridges.
Triumph Explosives, Inc., Elkton, Md., $102,730 for aircraft engine cartridges.

Chilean Air Progress

The Linas Aereo Nacional Chilene, perhaps better known as the L.A.N., shows excellent results for the first three months of 1941, while the whole year promises to break all records. L.A.N., with exclusive rights in Chile, operates 10 planes, mostly 10-seaters.

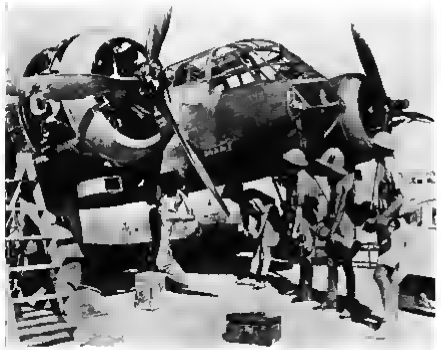
The main route is the five times weekly Santiago-Arica-Sanitago route, a distance of over 2,000 miles, but surveys are already being made for further extensions, not only in Chile proper, but to Buenos Aires, Lima and La Paz. Results for the first three months of 1941 follow, with those of 1940's twelve months in parentheses: miles flown 144,500 (355,160); hours flown 1,191 (2,829); passengers 1,500 (2,575); passenger miles 704,000 (1,295,000); mail 4,475 lb (15,900 lb.); freight 11,500 lb (35,900 lb.)

Sovfoto

ELEVEN GLIDERS IN TOW of a twin-engined Russian bomber (which appears to be the MBR 2), which may have been duplicated by the Germans in the Cretan assault. Gliders are used for hauling freight over certain regular air routes in USSR.

Inic ni i anal

AMPHIBIAN GLIDERS, such as this one-place job, were experimented with by the Nazis long before Crete invasion.



International

A LOAD OF TROUBLE for Hitler's and Mussolini's boys. British troops in Egypt are loading a Blenheim bomber.

On Schedule

By "Vista"

The development of the war in the Near East has seriously affected the airlines still operating in that section of the world. Reports now coming in indicate that the Holland KLM has had to cut down the length of its Amsterdam-Batavia route for the third time, and is now using Karachi as its terminus. The start of the war forced this company to change its base of operations to Naples, then with the invasion of the Lowlands everyone moved again, this time to Lydda, Palestine, and now they have been forced to again look for other quarters. Just what influence the developments in the Near East will have on the services of British Airways could not immediately be ascertained. Information available in New York indicates that their "horseshoe" route, which connects the Empire, is broken between Cairo and Karachi, and no further news as to developments, even with the new Iraqi regime, can be obtained. Speedy resumption of this vital link in Empire communications is logical though. The Italian line to Baghdad was stopped when the Italo-Greek hostilities began, and the German route to Teheran in Persia became highly irregular quite some time ago. The events now taking place in Syria and Iraq make a reopening of these services seem highly improbable, but not impossible.

The South American situation continues to show one development after another, all in favor of this hemisphere and its truly domestic airlines. Pan American Grace Airways has received the franchise and necessary funds to operate the Lloyd Aereo Boliviano, recently taken over by the Brazilian Government. One service is already in operation, and plans for added local services are in a far advanced stage. These developments appear to be the first concrete results of Tom Herdin's new position as president of a corporation to develop American air services in Latin America, in direct competition with Axis routes. Second item concerns unconfirmed reports that Pan American is planning survey flights across the center of South America from Peru to Rio de Janeiro, the import of such plans is obvious—this service would establish a route running virtually parallel to the lines of the Condor Syndicate, at the same time offering a faster east-west connection by eliminating the trip down to Santiago, then across the Andes to Buenos Aires, and from there north to Rio de Janeiro, which must now be made if one wishes to remain aboard American airplanes.

Good news comes from Australia, where civil aviation, after a few anxious moments at the start of the war when most modern civil aircraft were taken over by the Government, is again in full swing. The enormous expansion of the inland services, the excellent connections which Australia now has with the United States via both Singapore and Auckland, have significance in the Far East. In the year ending June 30, 1940 there were no fatal accidents on regularly scheduled air routes, and only 22 fatalities in the enormous amount of civil flying done in Australia. Plane miles show a drop of 1½ million miles to 8 million, but, on the other hand, the increased use of airplanes for travel in any country working on defense shows in the passenger-mile figures, up to 49 million from 43 million. Mail dropped from 1,400,000 lb to 850,000 lb., partially due to the elimination of the all-up Empire airmail scheme. Most important extension of civil air routes was the new line to New Zealand, which connects with Pan American's Auckland service.

All indications are that the Boeing flying boats for England, of which the first, the "Bristol" has been delivered, will be used in a modified trans-atlantic service from England to Canada. In addition, it appears probable that Pan American will once again have a line over the North Atlantic this summer, if the negotiations now under way in Dublin between Mr. Hinckley and Eire are successful.


Wide World

Clipper-bound for London were (l.) **GENERAL RALPH ROYCE**, new Assistant Military Attache for Air, to take over his post at the U. S. Embassy; (r.) **ROBERT H. HINCKLEY**, Asst. Secretary of Commerce for Aviation, to study military adaptations of civil aviation in England. Accompanying him was Major Lucius D. Clay, secretary of the War-Navy-Commerce departments' joint board for approval of airport construction.

Wide World

HAWLEY BOWLUS is president of National Association of Sailplane Manufacturers, newly formed by manufacturers Bowlus, Briegleb, Schweizer and Frankfort, to develop military glider projects.

He can smile, for his blind landing system won the $5000 first prize in the Revere competition for best contribution by a worker to defense plans. He's **EUGENE PHILLIPS**, CAA radio electrician.

Blackstone Studios

DONALD A. DUFF has been appointed general traffic and sales manager of Northeast Airlines. He's been in air transport since 1930, latterly with Pennsylvania-Central as eastern division traffic manager.

MARK HEANEY has joined Bell Aircraft Corp. as one of its test pilots. He served with the Marine Corps as pilot and has since been engaged in experimental flying and commercial aviation.



Ordered to active duty, **D. W. TOMLINSON** (l.), vice president in charge of engineering for TWA, has been granted a leave of absence to become commanding officer of the Naval Reserve Aviation Base at Fairfax Airport, Kansas City. His duties will be assumed by **J. C. FRANKLIN** (c.), executive assistant and corporate secretary, who relinquishes the post of corporate secretary to Paul E. Richter, executive vice president. **C. W. HERRE** (r.), assistant to E. Lee Talman, vice president and treasurer, was promoted to executive assistant and assistant secretary. Franklin was the winner of the National Air Board Safety Award for 1937.

ARTHUR THOMPSON has joined Fleetwings to fill an important position in the contracts department. Ten of his many years in the aircraft industry were with Stinson, Aircraft Division.

Wide World

New York's **MAYOR F. H. LAGUARDIA** is named Director of Civilian Defense to coordinate civilian home defense efforts. Brig. Gen. L. D. Gasser represents the War Dept. on the Board.

Personnel management at Braniff Airways' Love Field base will be under the direction of **MALCOLM HARRISON**, formerly with Texas State Employment Service where he handled Braniff personnel.

Jones Dabney Division of Devoe & Raynolds is now actively engaged in production of aircraft finishes, and has appointed **HERBERT C. REED** manager of the Aircraft Finishes Division at Malden, Mass.

Aircraft Accessories Corp. of Burbank announces that **RALPH MIDDLETON** (l.) is associated with the company as chief engineer. He was formerly with Curtiss Wright at St. Louis. **RODNEY B. CAMPBELL** continues as consulting engineer. **JAMES A. LANE** (r.) has been placed in charge of production at the Burbank plant, succeeding G. A. Theobald. Mr. Lane has had extensive engineering, sales and management experience.

Safety 'Chute

Incorporating a new principle in construction, a parachute made by Dr. Christian A. Volf of New York, N. Y., was drop-tested recently in Glendale, Calif.

By means of an inverted cone, rate of descent is said to be decreased and greater stability obtained, thereby overcoming drift in a high wind. A further object in the new design has been to reduce the size of the present standard parachute and so cut down materials and bulk.

According to the inventor, maximum strain on the 'chute exists at the outer edges where the greatest shock is absorbed upon opening. As a result of the cone, the apex, which becomes the point of attack, tends to build up a greater velocity of air toward the center of the canopy to a velocity about four times greater than rate of descent. The high velocity air strikes the canopy over an area where maximum tensile strength prevails.

Dr. Volf, who holds many patents in the aerodynamic and acoustical fields, expects to build a 'chute only 15 ft. in diameter having additional vents situated in the canopy to permit release of the high velocity air moving into the canopy as a result of the cone. It is expected that this size will be sufficient to carry down a 220 lb. pilot at a speed not exceeding 18 ft. per second, and that the present pilot 'chutes can be eliminated because of the cone.

Boeing Strato-Chamber

Group training of flight crews for extreme altitude test work is being carried out by Boeing Aircraft with a sealed tank which reproduces flying conditions at 35,000 ft.

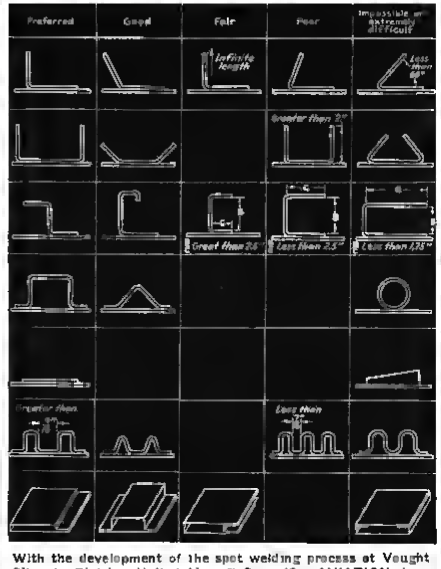
With both Britain and Germany building planes for combat at altitudes of seven miles, pilots will require careful training, and "stratosphere conditioning" will be a necessity. Boeing's strato-chamber will prepare a whole crew of trained engineers to go into the stratosphere to gather test data on the operation of turbo-superchargers in the Boeing B-17 type.

It has been found that if a man's oxygen supply is cut off at 20,000 ft., he will pass out in ten minutes. At 25,000 ft. unconsciousness comes in three minutes, and at 29,000 ft. the flyer passes a critical point at which loss of oxygen means unconsciousness in less than one minute.

Above 35,000 ft. an oxygen mask may furnish enough pure oxygen, but the rarified atmosphere doesn't supply enough lung pressure, and breathing is as difficult at 40,000 ft. with a mask as it would be at 18,000 ft. without one. Thus, 40,000 ft. seems to be the limit of human endurance without pressure cabin equipped planes or pressurized suits and helmets.

The strato-chamber can reproduce flight conditions up to 40,000 ft., and can accommodate three trainees and their equipment. Vacuum pumps reduce inside pressure to the equivalent of atmosphere pressure at any altitude. To guard against "aeroembolism", an effect similar to a diver's "bends", pure oxygen is breathed previous to the flight to "denitrogenize" the blood. The trainees then enter the tank wearing complete flying equipment; the door is closed, pumps start, and the flyers begin their "journey" to 35,000 ft. At various altitudes they practice handling their equipment under simulated emergency conditions.

As a result of the strato-chamber tests, the Mayo Laboratory of Aviation Medicine has adopted the Boeing check-off list for stratosphere flight crews. This list is a step-by-step procedure for crews to follow in preparing for any flight above 25,000 ft.



With the development of the spot welding process at Vought Sikorsky Division, United Aircraft Corp. (See AVIATION, June, 1940, pg. 62), consideration had to be given to the type of channel and stiffener section used in airplane construction. This was so that with the spotwelding equipment available these sections could be assembled easily. The chart above shows the preferred designs for the engineer to follow.

Allison Power Increase

Less than one pound per horsepower is the result of improvements on the Allison V-1710 engine when 175 hp. was added without increasing its size.

The improved model has passed tests delivering 1325 hp. at take-off and military rating against 1150 hp. top rating on Allisons heretofore. Weighing 1303 lb., ready for installation, the 1325 hp. model involves no radical changes from the older engine.

New Transfer Film

A photographic material for sensitizing metal plates in a template process that shortens time between engineering and test flights from two to four months, is announced by Eastman Kodak Company.

Called the Matte Transfer Film, use of this material in Lockheed's new photo-loft-template process has cut production costs by approximately $20,000 a model. Engineering drawings can be printed either by contact or by projection on these photo-sensitive metal sheets and the processed plates bearing the photographic image are sent directly to the template department to be cut and used as a pattern. The templates are made by cutting around the photographic outline by saw or mechanical shears. Other machining operations to which the photosensitized sheets are subjected are filing, drilling and punching. The costly and time-consuming step of making layouts on metal by hand from blueprints, or the necessity of duplicate inspection, is thus avoided.

In the contact method, engineering drawings are made on metal plates having a coating which will fluoresce in presence of x-rays. This coating is of such nature that it can be drawn upon satisfactorily. If positive prints on the metal are desired, a photosensitive glass plate is placed in contact with a treated surface of plate bearing the mechanical drawing, and the exposure is made by x-ray through back of the metal plate. The processed glass negative is then printed onto a sheet of photosensitive metal in usual way. If a mirror image negative on metal is used for the templates, the photosensitized metal is placed in contact with the treated metal drawing sheet and exposed through the back by x-ray.

Lockheed has made satisfactory use of enlargements of mechanical drawings on photo-sensitized metal plates. The drawings are made directly upon lacquered metal sheets and are then photographed on glass plates in a special camera. These glass negatives are then enlarged onto the photosensitized metal sheets. By this method photo-templates as large as 4x12 ft. have been made, and if care is taken in selecting cameras and lenses, it is reported photo-templates can be made with a tolerance of 0.001 in. per foot.

Line Priorities Tighten Vacation Push Slackens

Travel priorities on the airlines are tightening up. Much defense official travel is clearing through OPM. When a trip is full and a government or service man wants a seat, his office calls the airline and "requests" that room be made for him. The airline could refuse, legally, because it is still legally responsible to the holders of reservations.

But it *doesn't* refuse; there would be no point to it. The government could, and may at any time, put on legal priorities for defense. Besides, the operators are cooperating fully in the defense effort.

The airline has two choices in making room for government "must" riders: it can try to pick out a civilian ticket holder whose business seems least urgent. This is a form of discrimination which the lines do not enjoy. Sometimes the man it singles out to be grounded makes a squawk and proves that the ox should have fallen on somebody else.

Or, if the trip is a sleeper plane (which normally carries only its sleeping complement and has unoccupied day seats) the line puts on the extra must passengers, lightens its fuel load, and makes additional fuel stops.

Government travel and urgent business travel are the reasons the airlines are not pushing their "budget" travel plans under the Travelers Credit Corporation. They feel that defense travel should come first. Nearly 100 percent of the budget applicants are summer trippers.

In the case of Pan American Airways, when seat shortages exist, decision concerning official trips is handled almost entirely by the State Department. Both domestic and foreign service lines are becoming more and more the communication lines of the government. One of the few bright spots in that situation, from the lines' point of view, is that the government will have to give them airplanes—and crews. Right now, air crews are more critical than airplanes.

New 15%-Off Cards

After years of discussion, sometimes in raised voices, the airlines have got together on a standard air travel card, planned for use on July 1.

THE CHICAGO AIRPORT is at last to get rid of its railroad tracks! For many years airline pilots have cursed bitterly at this hazard but full-length runways will soon be in use. Entire field will be about 640 acres. It will have over 12 miles of paved runways, the most in the world, which will be from 5,200 ft. to 7,226 ft. long

British Atlantic Line For Emergency Service

Washington (AVIATION Bureau)—A transatlantic ferry service has been started by the British, with U. S. terminal at Pan American's Baltimore base, using the three Boeing boats which PAA has released to England. One is still to be delivered.

Behind this British move is seen the possibility that Pan American Airways might have to abandon the Atlantic run. The Nazis might overrun Spain and Portugal and occupy Lisbon, the only open port in Europe. The President could let PAA through the combat zone into Ireland, but that emerald isle might one day join the belligerents. Atlantic air communication is essential between the United States and Britain. If PAA dropped out, Imperial would carry on.

No attacks have ever been reported on either Lufthansa or Imperial, both of which are still operating in Europe. This leads some persons to believe that PAA could operate out of a belligerent Lisbon, or Ireland. They believe that, if the U. S. joined the war, PAA might continue in Europe without incident. Of course Germany regards both Imperial and PAA cargo as contraband, but the Nazis too wish to continue vital commercial flying throughout Europe. Thus the standing airline armistice.

Army Eyes Air Express Capacity and Schedules

If you have read about the Army's survey of Railway Express Agency's ability to carry emergency air express, you will be interested in the reasons why. First, there is nothing new about Army use of air express; it has been going on all the time. But in view of imminent large increase in urgent volume, the Quartermaster Corps, which handles all Army transportation, has been looking over REA's depot facilities for storage, checking up on its schedules, and the capacity of airline planes which are carrying the express.

In other words, Army wants to know just what to expect. One interesting point is that Army took account of transport plane capacities with the seats removed. This means that, if necessary, to move a volume of strategic parts or materials, all airline space would be taken over. Of course the Army pays regular rates for service. This express survey has nothing to do with the freight lines operated by the Air Corps itself, which has been reported in this magazine.

RE-ESTABLISHMENT OF AIRLINE SERVICE at Newark Airport after year of idleness gives air lines two terminals in New York area. Left to right, John B. Walker, pres. of Airlines Terminal in New York, Col. Ewin Aldrin, manager of Newark Airport, Capt. W. H. Kennedy, UAL pilot, and J. E. Sommers, CAA, look over Capt. Kennedy's report after United's first check flight into re-opened airport.

About Transport Planes

TWA announces orders placed for Lockheed "Constellation" transport planes, to carry 64 passengers; 4 Wright engines of 2,500 hp. each, still to be announced, speed, 350 m.p.h.; capacity net load, 16 tons; range 4,000 miles; ceiling 30,000 ft.; cabin and engines supercharged. Company has ordered 40 of these ships, but OPM priority division authorizes only three as yet. Whether any more will be permitted built is still to be decided. The Army is showing some interest in this transport type, and also in its military prototype.

Another interesting development in transport equipment is issue of an airworthiness certificate to the DC-4. There are 61 on order to the airlines, but OPM has given the green light on nine—for the Army. CAA's reference to deficient landing speed requirements means nothing but that the Army intends to overload them. The original DC-4, which was larger than present design, was sold to Japan.

48 Route Applications

The Civil Aeronautics Board has before it 48 applications from 24 different air carriers for a network of almost 14,000 miles of route, which, if granted, would bring the U. S. total to 35,000. Seven of the applicants are new companies. Several of the applications are for the same routes. The majority of them are for lines in the Mississippi Valley.

Under a new arrangement between CAB and the War Department, the Board can go ahead with hearings and grant certificates, but the certificate holder cannot start operations without permission of the War Department. This enables the board to go right ahead with its work, and it gives the applicant a certificate which he knows will be valid soon or late, on which he can base plans.

CAB Studies Pick-up

A study of eight applications for pick-up systems is being made by CAB. The original All-American (du Pont) system is still the only pick-up in operation. But its potentialities are shown in its 50 percent traffic increase since February when total poundage was 11,000. Company is preparing data to submit with its application for New England system.

Whether the Army, which must now agree before new certificated routes can start operations, will okay more pickup lines is yet to be seen. One point in their favor is that most of them are proposed for industrial areas, and they would speed defense business. Another is that they cover a myriad of small towns and can command heavy support in Congress.

Talk About Weather

The 35 existing radio sonde stations should be supplemented by "many more" to provide adequate weather information to airlines and military pilots according to a current Weather Bureau report. The Bureau hopes to develop sonde that will float at a given elevation supplying continuous information of changing conditions at that level.

The use of television in airways weather service is under consideration, with Bureau experts anticipating complete weather maps flashed on a cockpit screen. Evolution of rockets probing higher into the stratosphere is foreseen.

TRANSPORT DOINGS

Pan-Central gets a fleet of 14 air-conditioning trucks to keep cabins cool on the ground. Replaces ten passenger planes on Detroit-Sault Ste. Marie route with DC-3, also on new Grand Rapids-Traverse City route. Company engages its 1010th employee—Miss Helen Paul. Is first airline to take up Washington headquarters at the New Washington National Airport. Carries more passengers in April than in any previous month in 14-year history.

Western Air Express asks to change its name to Western Air Lines Inc.

Eastern Air Lines asks CAB for non-stop Chicago-Nashville. Inaugurates direct passenger service Louisville-Evansville, St. Louis. Asks certificate for east-west service to offset the summer slump in its north-south traffic.

Mid-Continent Airlines is installing $50,000 worth of machinery and equipment at Minneapolis municipal airport when new $125,000 hangar is completed.

United Air Lines adds 60 co-pilots following completion of instruction courses at United's training school. Company awards plaques to six employees for pioneering early air transport. Wives of pilots, mechanics and employees meet at LaGuardia Field, organized UAL Women's Defense Aid Corps.

Trans-Canada establishes new non-stop Toronto-New York record in the new Lockheed Lodestar. 377 field-to-field miles in 1¼ hours. Old record 2 hours. Blackout curtains are stock equipment in Canadian planes. 100 company radio operators go to school in spare time in study aeronautical meteorology.

Northwest Airlines claims definite evidence that the phenomenal records for air travel established last year will be broken during 1941. Celebrates 15th anniversary this year.

Transcontinental & Western asks for Pittsburgh-Boston. For vacations, the company offers convenience of deferred payments spread over entire year.

American Airlines inaugurates Toronto-Buffalo service. Company re-establishes service at Newark, N. J. Offers service from New York and Chicago to Toronto.

Canadian Colonial Airways claims commuter service isn't far off.

AIR TRANSPORT INDICATOR

June 1, 1941

135.00

Which is the ratio of passenger miles reported by the Air Transport Association for all domestic lines for May, 1941, to the figure for May, 1940. Total for the indicator has continued to rise from last year's low. For the first five months of 1941 traffic stood at 442,710,716 revenue passenger miles—up 34.9 percent over May, 1941.

See Finance page for individual companies' traffic figures

By Raymond Hoadley

The new emphasis on heavy bombers as a prime defense weapon has perked up Wall St. interest in such aircraft companies as Consolidated and Boeing whose unfilled orders for this type of craft now place them among the first six ranking companies from the standpoint of current backlogs. Through the accelerated bomber program the automobile companies have entered the aircraft defense picture with both feet. Ford will be the first motor company to make a complete military plane and three divisions of General Motors will be manufacturing aircraft engines in 1942. Financial observers are wondering whether the automobile industry will step out of the aviation field as quickly as it will abandon tanks machine guns and shells when the war is over. Much may depend on their ability to make military aircraft profitably. Meanwhile in another branch of aviation May and June traffic operations were encouraging to the airlines and should nearly offset the poor results suffered profitwise in the first quarter of the year

Consolidated Aircraft—currently the fastest growing aircraft company—declared the $2 a share common dividend last month that Wall St. had predicted, but sprang a surprise on the financial dopesters when directors proposed to double the authorized common stock. At the same time the preferred stock, one of the few senior aircraft issues outstanding, was called for retirement. The financial district is puzzling over the purpose of the common stock proposal and still gasping at the sudden jump in unfilled orders from $300,000,000 to $684,000,000. Sales in the first half of 1941 are expected to be more than double those for all of 1940.

Domestic airlines established an all-time record for passenger traffic in May, months ahead of the usual seasonal peak. For the first five months of 1941 the 17 lines flew approximately 455,000,000 revenue passenger-miles, an increase of about 30 percent over the 351,904,000 miles flown a year ago.

North American Aviation stockholders doubtless were worried when word came through that the Army had marched in and taken possession of their plant. All qualms over temporary federal operation were removed however when Secretary Stimson went out of his way to pay high tribute to the company's president, James H "Dutch" Kindleberger. From his remarks it appeared that shareholders had nothing to lose from federal intervention and the stock advanced on the first day the plant was taken over.

More than one million commercial shipments were carried by airplanes in the United States last year to 48 states, 31 nations and 5 continents. The biggest spurt in domestic air shipments this year will come from the Army's recent decision to use air transport for the quick delivery of replacement parts, tools, motors, blueprints, patterns or even new machinery whenever emergencies prevail in defense production. In the past air express has been used chiefly for transporting serums.

Despite large gains in passenger and cargo traffic United Air Lines reported a net loss of over one million dollars in the March quarter. W. A. Patterson, president, in a report to shareholders stated that 20 percent more air mail was carried at the same revenue as a year ago while other higher cost factors were taxes, training expense and additional personnel.

Capacity operations in all plants of the Square D Co., including the Kollsman Aircraft Instrument Division, should bring earnings for the first half of 1941 well above the $2.03 a share reported last year in the corresponding period. One thousand shares of the 5 percent preferred stock, of which 20,000 shares now outstanding, recently was called for retirement.

Bendix Aviation has a backlog of unfilled orders well in excess of $215,000,000 even though deliveries are now approximately 150 percent higher than one year ago. Reflection of this big increase in delivery volume is found in the March quarter profits as tabulated in the earnings table on this page. Earnings of the company are now running at the rate of $5 a share per year, as against $2.57 a year ago.

Bell Aircraft deliveries in the first half of 1941 are estimated to be fairly close to the $5,188,000 sales for all of 1940. Volume this year may drop below previous early estimates of $40,000,000 due to a lag in engines and other parts needed for assembly. However the spurt expected from July on should bring deliveries for the year to approximately $30,000,000 and result in profits well above the $1.14 a share reported for 1940. A recent wage increase will boost the Bell payroll by $1,225,000, an amount several times 1940 earnings of $284,000.

Vultee's new $32,000,000 order brings its backlog close to $130,000,000. But the biggest news from Vultee Field is the first powered, mechanized final assembly line in the industry. A four-fold increase in output resulted for the company. Higher taxes, inflated labor and raw material costs, and lower profit margins on domestic military and lease-lend business, which now totals more than 50 percent of unfilled orders, makes the swift transition from the old custom-built basis a dominating factor in increasing or even maintaining recent earning power.

Domestic airlines would be guaranteed profitable operations under a new formula submitted to them for their consideration by the Civil Aeronautics Board. The service payment to an unprofitable operator would consist of an amount equal to the deficit, plus the equivalent of a

Industry Backlog

Unfilled orders of the aircraft industry show the sharpest rise since the defense program due to the large orders placed recently for the costly four-engine bombers. As a result backlogs of the aircraft manufacturers have jumped nearly $700,000,000 in the past month, despite steadily increasing deliveries, and now stand at approximately $4,630,000,000—a new all-time high record. President Roosevelt has asked Congress to speed appropriations for $3,329,000,000 for Army and Navy planes in addition to the $2,000,000,000 that the Army already had put into aircraft before receiving an additional $1,000,000,000 supplemental appropriation in April. The War Department has spent $420,000,000 and the Navy $139,000,000 for aircraft plant expansions. At the request of the Office of Production Management, the RFC has earmarked an additional $350,000,000 for new plants. Work on the new orders probably will not begin until well into 1942, but their allotment now will permit the industry to plan in advance for raw materials, labor-training, expansion and subcontracting. One year ago unfilled orders of the industry hovered around the one billion mark and a $25,000,000 plant expansion program was emerging from blueprints. The following table gives the latest approximate backlogs of 26 primary plane and engine producers

Allison	$150,000,000
Aviation Corp	15,000,000
Beech	80,000,000
Bell	68,000,000
Boeing	285,000,000
Brewster	30,500,000
Buick	31,200,000
Cessna	20,000,000
Consolidated	684,000,000
Continental Motors	30,000,000
Curtiss-Wright	685,000,000
Douglas	[illegible]
Fairchild Engine	20,500,000
Ford	192,500,000
Grumman	85,000,000
Lockheed	220,000,000
Martin	320,000,000
North American	136,000,000
Northrop	30,000,000
Packard	167,000,000
Republic	80,000,000
Ryan	10,500,000
Studebaker	33,000,000
United Aircraft	330,000,000
Vega	74,500,000
Vultee	127,000,000
	$4,631,800,000

Current Earnings Reports

Company	Period	Net Profits 1941	Net Profits 1940	Profits per share 1941	Profits per share 1940
Aeronautical Corp	3 mos Mar 31	$15,500			
Air Associates	6 mos. Mar 31	175,020	$123,293	$1.39	$1.14
Beech Aircraft	6 mos	L 52,494	L 82,494		
Bendix Aviation	3 mos	5,004,862	3,332,769	2.61	1.59
Briggs Mfg	3 mos Mar 31	1,810,443	2,395,202	0.92	1.21
Ex-Cell-O Corp	3 mos.	538,582	577,495	1.35	1.40
Packard Motors	3 mos	274,272	38,400	0.02	
United Air Lines	3 mos. Mar 31	L 1,014,273	L 238,951		

L — Net Loss

certain percentage of its operating revenues. An alternate proposal would permit companies greater freedom in altering operations but would continue CAB supervision over expenditures The board emphasized it had not approved either of these plans and would be guided by industry reaction to them.

Thompson Products June quarter sales are estimated at around $10,000,000, a considerable gain over the $8,801,000 peak established in the March quarter. Plant expansions are under way that will enable the company to continue the recent production records About 40 percent of recent shipments have been for aircraft parts

Ryan Aeronautical has closed contracts exceeding $2,000,000 for products of the exhaust manifold division. Deliveries of this division alone have been running over $320,000 monthly according to T. Claude Ryan, company president.

Here and There . . . A. Felix du Pont, Jr has become a director of *Bellanca Aircraft* . . . *Sperry Corp* has a record backlog of more than $150,000,000 . . . *Aviation Corp* is expanding its far-flung activities by building a government-financed $8,700,000 propeller plant at Toledo . . . Trade circles feel confident that the airlines will have sufficient new equipment to handle the 1941 traffic gain . . . Financial circles were pleased at Washington reports that William B Harding, Wall Street broker and aviation authority, would be associated with the new airlines credit agency formed to finance Latin American airlines . . . *Pan American Airways* reports a 37 percent traffic gain in the first quarter this year . . . *Aircraft Accessories* of Los Angeles is making a public offering of 60,000 preferred shares through an underwriting group . . . *Ford* may increase its planned output of Pratt & Whitney engines by 150 percent . . . *Cessna* has delivered 100 training planes to the Royal Canadian Air Force . . . *Lockheed* deliveries are ahead of the full 12 months of 1940 . . . Allison division of *General Motors* has granted a $2,000,000 wage increase . . . *Menasco* is doubling the present plant which was completed last October and enlarged in January.

Security transactions by company officials and principal stockholders in April, according to the latest SEC report included the following purchases: 2,000 shares of Air Associates by Randolph C. Walker, 1,500 Beech Aircraft by John P. Coty, 2,000 Pan American Airways by Thomas A. Morgan, 100 North American Aviation by Robert A. Lambeth and 300 Vega by Courtlandt S. Gross William Littlewood gave away 500 shares of American Airlines while Armin A. Schlesinger sold 500 Square D and Peter Fraser disposed of 200 shares of United Aircraft Ralph Damon, new president of Republic Aviation, acquired 100 shares of stock in that company.

Glenn L. Martin Co. has secured a $1,000,000 loan from the Guaranty Trust Co of New York for use as additional working capital while the Reconstruction Finance Corp. has authorized an additional loan of $446,510 to Beech Aircraft Corp. to be used in connection with completion of airplane contracts. Beech also has established a wage bonus plan which company officials estimate will add approximately $500,000 to payroll expenditures.

1942 Air Appropriations

Aviation's role in the front line of modern war is given spectacular recognition in the new War Department appropriation for the forthcoming fiscal year, which allocates about one-half of the record-breaking ten billion dollar total for military aviation

Covering funds for 12,856 additional aircraft, bringing the Air Corps up to 50,000 plane strength, the measure also provides money for maintaining a 281,154-man Air Corps, for training 30,000 pilots and for starting a 8,000 barrage balloon program.

Some $45,000,000 is provided for air base facilities, $42,875,200 for aviation experiment and research, $750,000 for purchase of autogiros. The additional aircraft, estimated to cost $2,048,142,066, make necessary a $284,012,785 fund for aircraft ordnance and signal corps equipment.

Another $350,524,800 is included for expediting military production.

The total appropriation for the Air Corps adds up to $4,241,738,322 cash and $104,238,978 contract authority.

Meanwhile, the House Appropriations Committee is well along with another supplemental defense appropriation. The President is asking for $482,046,000 for additional aircraft for the Navy plus a $10,000,000 contract authority for aircraft plant facilities.

Also, a request is pending for $1,346,000 to enlarge the NACA Langley Field laboratory and for authority to raise the limit of expenditure on the new NACA engine laboratory from $8,400,000 to $12,300,000.

New funds are sought for air mail service, too, including payment of retroactive rate increases for Braniff on AM-15 and for service by Delta on AM-24, by Pennsylvania Central on AM-55, by American Airlines on AM-50 and by United on AM-67.

Money for additional operations by Pan American Grace Airways has been requested—for two weekly trips just beginning between Bolivia and Brazil and for increased schedules between Ecuador and Oruro, Bolivia, and from Arica, Chile, to Oruro, Bolivia.

Appropriation figures you should bear in mind, are quite unimportant. There is now no limit on appropriations; any defense project gets all it can use. Almost the sole objective in the program is to increase production and improve design of munitions.

TWA's Annual Competition

First prize in TWA's annual award for "best informed air transport writing" during 1940 went to Capt. Sherman B Altick, aviation editor of the New York *Sun*, in the "open" division, with Reginald Cleveland (*New York Times*) and Herb Preeg (*Los Angeles News*) placing second and third.

In the magazine class, W. B Courtney of *Collier's* took top honors and F. Barrows Colton (*National Geographic*) and Eric Bramley (*American Aviation*) received second and third Dick Darrow of the Columbus, Ohio, *Citizen*, Douglas Ingells (Dayton *Journal-Herald*) and Helen Waterhouse (Akron *Beacon-Journal*) were first, second and third winners in the division for newspapers under 100,000 circulation Robert Selig of the New York *Daily News* got first in the photographic division, with John Hemmer (N. Y *Daily News*) and Gus Pegnarella (Philadelphia *Public Ledger*) ranking second and third

A special award was given to Dick Kirschbaum of the Newark *News* for high standard of reporting of aviation news over a period of five years, especially for his work in aiding the restoration of airline service into Newark

United Hunts Mesotrons

In search of facts about mysterious cosmic particles, including the mesotron, which might explain the world's beginning, scientists of the University of Chicago will ascend to about 30,000 ft. over Chicago in a specially-equipped United Air Lines Mainliner.

Six miles above the ground Winston Bostick and Donald Hughes, of the university's physics department, will conduct their study which is under the guidance of Dr Arthur H Compton. Equipped with a 700-lb magnet, heavy batteries, a "Wilson cloud chamber" and "geiger counters", by which the cosmic ray can be studied and photographed at high altitudes, the ascent begins at dawn W. W Davies, United's research engineer and oxygen expert, Capt. W E Larned, pilot and first officer, will round out the force.

Bell Aircraft, after negotiation with the CIO union in the shop, granted a 10-c increase and a 65-c. minimum after a month's employment, 70 cents after two months The Bell union contract provides for wage revision when price indices rise.

Menasco has signed a contract with the AFL machinists, who won an NLRB election Starting wage is 51 cents for two months, 57 for four, and then 63.

Beech Aircraft granted a 2½ cent raise, under an arrangement in its AFL machinists' contract, when production of twin-engine ships reached 20 a month. A second raise is scheduled when 50 is reached

Vacations have been waived by Curtiss-Wright and Republic employees, who get extra pay instead

Los Angeles Chamber of Commerce, which a year ago was warning job-seekers to stay out of Southern California, is now publicizing the demand of aircraft plants there for skilled and unskilled men, with either experience or trade-school training

Material shortages are also worrying manufacturers of model kits Aluminum for engines and balsa wood are the problems Conferences have been held with priority officials.

Calling Names

James C. Beakes and **Fred W. Ford** are appointed respectively controller and purchasing agent of Ryan Aeronautical Co

John P. Aldridge, assistant to **C. R. Chatfield** of United Aircraft, is on leave of absence to go on extended duty in the office of the Chief of the Air Corps.

A. J. Valley's appointment as hydraulics engineer for Adel Precision Products is announced by President **H. Ray Ellinwood**.

Arthur Nutt, v.p. in charge of engineering at Wright Aeronautical, and **Harry G. Stoddard**, president of Wyman-Gordon receive honorary degree of Doctor of Engineering from Worcester Polytechnic Institute

Glenn L. Martin receives honorary degree of Doctor of Science from Brown University

Ruth Haviland, head of women's traffic department for United Air Lines marries **William B. Wood**, former New York salesman for United now in Army

Jene Bowman, Penn Central hostess marries **Capt. Ralph B. Read**, of the same line

Columbia Broadcasting singles out individual defense workers for coast-to-coast salute on "Proudly We Hail" new program started June 6

NATA suggests CPT students in college get a "letter" like that of athletic stars, for excellence in the air

Brig Gen. William O. Ryan commands the 10th Pursuit Wing at Hamilton Field

Howard Aireraft Delivers Trainers

Officials of Howard Aireraft Corporation of Chicago advise that Howard DGA-125 Trainers have recently been delivered to Barber's Flying Service, Dallas Aviation School, Inc., Des Moines Flying Service, Inc., Hartford Flying Service, Hughes Flying Service, Lester O Jolly, Southern Air Service, Roscoe Turner Aeronautical Corp.

All of these operators are training cadets in Advanced Primary Flying under the sponsorship of the Civilian Pilot Training Program.

Production of these planes is being stepped up under the direction of E. D. DeWeese.

Luseombe Employees Form Flying Club

Virtually every department of the Luscombe Airplane Corporation's West Trenton plant is represented in the charter membership of the new employees' flying club. Present membership in Luscombe Fliers, Inc., numbers 30 men and women. An apprentice in the stockroom was among the first to sign up. Robert Riddle, superintendent of the Metal Surfaces Department, is president of Luscombe Fliers, Inc. An engineer, the Production Manager, and employees from Planning, Final Assembly, Sheet Metal, Shear, Sub-Assembly and Wing departments planned and organized the new club. A new plane is planned for each 20 member unit.

Designation by C. A. Sirrine, director of operations for Michigan WPA as one of Michigan's important defense fields, more than a half million dollars has been allocated to improve the Traverse City, Michigan, airport.

Approved by President Roosevelt, this amount comes in two awards, one for $406,000 and another for $135,000.

This field, unusual for size and evenness, has two north and south and one diagonal runways, each nearly a mile in length. At present these runways are 75 feet in width but, upon War Department recommendations, will be immediately changed to 150 feet and possibly wider. All runways are now hard surfaced.

The airport is now used by the Pennsylvania Central Airlines and as a base for the U. S. Coast Guard detached air patrol of the Great Lakes, as well as by private planes. It is equipped with hangars and also has a CAA weather bureau employing five weather experts.

Some of the trainers now in use at the Sparton School at Tulsa

Old Sunrise Airport in South Ozone Park, Queens, near New York City, a flying field of barnstorming days, is being reopened under the proprietorship of Archie Baxter, for use principally in training pilots under the government sponsored Civilian Pilot Training Program.

Baxter made arrangements to lease the field a few months ago, when recurring rumors that the Navy would take over Floyd Bennett Airport, Brooklyn, where he was located, induced him to look for a new site "when and if." The rumors materialized into fact, the Navy was given the airport as of May 26, and Baxter found Sunrise Airport waiting.

Re-birth of the flying field necessitated generous use of tractors, bulldozers, and grasscutters. Runways are to be installed and a hangar to accommodate at least 20 airplanes will be constructed during the summer.

Under pressure of the national defense drive airports are sprouting in Southern California and vicinity like mushrooms after a spring rain. With runway work nearing completion at Los Angeles and Santa Monica airports and field buildings soon to be erected, a $150,000 Administration building is under erection at near by Long Beach airport. Meanwhile ground-breaking ceremonies were held early in June for the new $1,000,000 Santa Barbara airport, and work has been speeded on the $339,725 WPA improvement project on Visalia Municipal Airport. And just over the border, in Arizona, a new $500,000 training center, Thunderbird Field, has been dedicated near Phoenix. Meanwhile an expansion program is underway at Phoenix Sky Harbor and the Army Air Corps has occupied its new million dollar air base at Tucson, Ariz. about 100 miles south of Phoenix.

Palm Beach

Plans were recently announced for the expansion of service facilities at Morrison Field, Palm Beach county airport at West Palm Beach, following the reorganization of Palm Beach Aero corporation and transfer of control to Thorne Donnelley, pioneer aviator of Chicago and Hobe Sound.

An approved repair station will be installed and completion of a second hangar to double storage capacity for private planes was announced by Wright Vermilya, Jr., who continues as head of the company. Mr. Donnelley who will serve as vice president and treasurer of the new company, has purchased the interests of J. Wesley Pope and brothers of Cincinnati. Mr. Donnelley was licensed in 1913, serving as flight superintendent there until his transfer to the Curtiss plant at Buffalo.

TRAINING

Major C. C. Moseley has grown to almost fabulous proportions in his importance to the military pilot training program in Southern California. Latest Moseley venture is the rush construction of a $400,000 flying school among the sage brush, jumper and joshua trees in the California Mojave desert near Lanrester, about 100 miles north of Los Angeles. Barracks for 400 students are going in and three-way paved runways will be ready by July 15th to serve for the start of training. R.A.F. recruits. Operated by Polaris flying school, an affiliate of Moseley's Cal-Aero Academy, the field will receive classes of British cadets at five week intervals, putting them through a ten-week primary training course.

An effort to obtain an adjustment in a recent order which virtually confines the establishment of air corps flying schools to the southern states is to be made by I. V. Packard, secretary of the Nebraska Aeronautics Commission. The order would permit the establishment of such schools in the vicinity of Kansas City, and Packard will try to prove that there is little difference between winters in Nebraska and in Kansas City. He said that he is somewhat encouraged by the fact that the air corps pilot quota has been increased from 14,000 to 30,000 per year; hence more training centers are needed. He also pointed out the consideration being given toward bringing some 14,000 air corps recruits to the United States for training from Canada and New Zealand.

Radio Technicians Needed

Royal Canadian Air Force officials said recently there is "urgent need" for 2,500 radio technicians—men who will be given a short intensive course in radio work in Canada and sent overseas to take their places in the ground defenses.

The R.C.A.F. has been recruiting skilled radio mechanics to take these posts for several months, "but this source of supply seems to have been nearly exhausted," it was said.

The R.C.A.F. now proposes to take untrained radio men, provided they have passed their junior matriculation or attained an equivalent standard. For this work, the age limit is from 18 to 45, with preference for those from 20 to 27. Medical standards will not be as strict as for those entering the air-crew, but call for "sound health." The radio men are asked to apply at R.A.C.F. recruiting stations.

With $300,000 already invested in the new Rankin Aeronautical Academy near Tulare, Calif., an additional $500,000 is scheduled for expenditure during the balance of 1941 in providing the school with a chain of five auxiliary flying fields at nearby Exeter, Lindsay, Porterville and Woodville. A total of 400 Army cadets will receive primary flight training at the Rankin flying center.

A revolutionary new aviation training plan has been developed by the Westwood School of Aeronautics, Los Angeles, Calif. Under the Westwood plan students register for instruction at a fixed service fee per month. Instruction continues as long as the student maintains his monthly payments, but he is not obligated to any amount beyond his current payment. A provision is made allowing a 90 day lapse in monthly payments without jeopardizing the student's position in keeping the agreement alive. This arrangement makes it possible for low-salaried persons to undertake aviation training without financial embarrassement

A goal of 500 flying cadets a month for the Army from New England has been set by the recently organized New England Flying Cadet Committee, of which Major Willis S Fitch of Boston is general chairman State chairmen include Maine, Guy P Gennett, publisher of the Portland Press-Herald; New Hampshire, Justin D Hartford publisher Portsmouth Herald; Vermont, publisher Burlington Free Press; Massachusetts, Raymond P Baldwin of Boston; Rhode Island, John W. Haley, advertising executive, Providence; Connecticut, Francis S Murphy general manager Hartford Times and chairman Connecticut Division, New England Council

Arizona School

Arizona's first school for training pilots under private contract for the Army was dedicated by Southwest Airways, Inc, Memorial Day, May 30th, when the first class of cadets graduated

The $500,000 training plant, established under the supervision of Leland Hayward, TWA director and well known flier, has been christened Thunderbird Field

Actively supervised by John Connelly, formerly in charge of flight testing for C A A on the Pacific Coast, who is now manager of Southwest Airways, the staff of 35 instructors at Thunderbird Field, 15 miles northwest of Phoenix in the Glendale district, is already training over 100 army student fliers.

Rankin Aeronautical Academy

Tex Rankin has opened the Rankin Aeronautical Academy to train pilots for the Air Corps. The new school has 980 acres available at present and has an option on 460 more acres One hundred cadets will be at the school at one time Instruction will be on some 18 Stearman PT-17 trainers.

Formed to foster more intensive investigation into aircraft service problems, both civil and military, the "Aircraft Manufacturers' Service Association" has been announced in Los Angeles A program of regular meetings has been inaugurated for the exchange of information and the furtherance of an educational and training program The following officers have been elected to serve for the balance of 1941: Mr Reagan Stunkel, Lockheed Aircraft Corp., President; Otto P Graff, Vega Airplane Co, vice president; James Thompson, Vultee Aircraft, Inc, Secretary; Thomas Bonde, North American Aviation, Inc, Treasurer; E. O. Cooper, Bendix Aviation, Ltd., Accessories Company Representative; James B Misner, Hughes Aircraft Co, Aircraft Company Representative; and Donald Sprague, Douglas Aircraft Company, Aircraft Company Representative

Miami School of Aeronautics

Newest Florida school for aircraft mechanics is the Miami School of Aeronautics, located in a building that formerly housed the Embassy night club. The school has 16 class rooms and 13,000 sq ft of floor space Accommodations are available for 300 students Courses include sheetmetal, welding engines, navigation, meteorology and aircraft structures. President of the school is Albert R. O'Clare. Carl Adams is vice president

New England Aircraft School

Gov. Saltonstall of Massachusetts helped the New England Aircraft School to dedicate its new building at the East Boston Airport recently The hangar is 165 by 90 ft. and is equipped with all modern teaching devices This school was founded in 1928 as an evening school, with 40 students It now has a quota of 600 students, including Air Corps mechanics

Mechanics from the Air Corps are housed in two Boston hotels and have bell hops to run their errands At present the school has 275 A C men but the number will soon be 300

Asserting that a "financial bottleneck" is retarding the fullest expansion of necessary aviation training work in this country, Major C. C Moseley, president of Curtiss-Wright Technical Institute, has proposed that the government finance prospective students. Says Moseley, "Let the government establish a revolving fund out of which unsecured, self liquidating loans may be made to young men who can meet the qualifications for enrollment in aeronautical schools bearing the approval of the Civil Aeronautics Authority These loans would bear a stated rate of interest and be repayable out of salary on a basis consistent with the young man's probable earning power and other circumstances." "The bottleneck of mechanics and engineers now vitally felt in the aircraft industry is not a bottleneck of manpower—but one of finances," Mosely added. Moseley claims that his firm has a list of 100,000 young men eager to become mechanics and engineers but who lack the necessary funds for this training Moseley suggests that, since the plan is self liquidating, it will cost the government nothing—a rare proposal in these troublous times

An entirely new departure in aeronautical engineering training Aero Industries Technical Institute has inaugurated a six month elective course in Production Sciences This includes Tool Engineering, Operations Engineering, Time and Motion Study, Production Planning, Production Design, Cost Estimating, Standards Engineering and Plant Layout. This is the second specialized phase of aeronautical engineering to be added to the established one and two year engineering courses of Aero ITI The first, Armament Design and Engineering, was added about a year ago Heading the new department in Production Sciences is John D Cox, formerly in the production analysis and design department of Lockheed Aircraft Corp

Early in July the city of Los Angeles will open a new $182,153 aircraft employee training center near the Los Angeles airport Covering 20,000 sq ft of floor space, the new plant is being equipped with $150,000 worth of tools and machinery and will accommodate more than 200 students at a time Instruction is to be carried on on a 24 hr. day basis in order to meet the need for trained aircraft factory workers. Courses will cover all phases of work including welding and machine shop instruction as well as the more conventional work in sheet metal layout and riveting.

Latest bid for fame of the Ryan Aeronautical Company is a listing of famous people or sons of famous people who are enrolled in the Ryan commercial flying school at San Diego Included in the imposing list are Whitelow Reid, son of the owners of the New York Herald-Tribune, John Brooks Knox, scion of the gelatine family; Edmund C Eppig, nephew of the late George Cardinal Mundelein, Archbishop of Chicago; Henry E Huntington, II, grandson of the pioneer railroad builder; David H Boothe, brother of Clare Boothe, playwright; and William H. Ryan, a cousin of Thomas Fortune Ryan III.

H. W. Hartley, president of the American School of Aircraft Instruments, announces completion of an expansion program which provides the most complete equipment and facilities for training in aircraft instrument maintenance and repair offered in any private institution. In accordance with the merit of instruction given by the American School of Aircraft Instruments the requirements of the civil service board for trained instrument technicians have been amended to recognize the school's six-month training course as complete substitution for the two years' experience ordinarily required of candidates

Peddie School Teaches Aviation

The Peddie preparatory school at Hightstown, N. J has inaugurated both a ground and flying course for its students The ground course costs $60 and runs for nine weeks It is given by Peddie instructors The flight course, for students 18 or over, costs $340 and provides from 35 to 50 hours of flying time Al Bennett, of Bennett Air Service, provides the flight instruction

Three Spot Landings

The CAB approves amendments to the Civil Air Regulations concerning tests of aeronautical skill.

Prior to the changes, the pilot was required to execute a spot landing after a 360-degree turn from 1500 feet and a spiralling approach from 2000 feet The Board's action requires, instead, three spot landings from a 180-degree approach turn and demonstration of his ability to spiral Serious collision accidents have occurred between training planes practicing these maneuvers, and other aircraft

It is hoped by the Board that the new regulations will improve flying conditions at the average airport by forcing students to improve practical landing ability

Recent Books

SOME ECONOMIC ASPECTS OF THE AIR EXPRESS BUSINESS, *by Arthur Dee Lewis*, Research Assistant in Transportation, University of Texas. Published by the Author. 112 pages, $2.50.

With interest growing in air express, this treatise is a timely investigation into the development and possibilities of air cargo carriage.

Divided into four sectional headings entitled I. History of Air Express, II. Economics of Air Express, III. Organizing for Air Express, and IV. Possibilities for Air Express, it treats extensively of rates and costs of operation, regulation, and organizational problems.

The author believes air express should be handled by one organization which should be owned by all organized passenger, mail and express airlines. Competition, he believes, would lead to wasteful duplication of facilities and a consequent rise in the unit cost with no added value given to national welfare. The belief is also advanced that shipments will be confined to articles of high value per unit of weight and bulk.

As to possibilities for air express, the most immediate problems, according to Mr. Lewis, are to find out where the potential traffic is located, how much there is, and where it will be going.

ENGINEERING DRAWING, *by Thomas E. French, M.E., D.Sc.* Published by the McGraw-Hill Book Company, Inc., New York. 662 pages, $3.00.

This sixth edition of the widely used and important text on engineering drawing has been revised so as to be of utmost value to the aircraft industry. Included in the new material is a chapter devoted solely to aircraft drawing with its contents lifted directly from the present day work of the aeronautical engineer and draftsman.

In gathering the data for this section the author collaborated with numerous well-known engineers in the aircraft factories to insure its usefulness and correctness. The introduction and the opening paragraphs of the chapter explain some of the drawing problems peculiar to the industry. Following this the reader is explained the general technique of aircraft drawing with a comprehensive group of paragraphs on the standards used throughout the industry. This is further brought to the attention of the reader by the problems at the end.

All of this material on aircraft drawing is in addition to the chapters on general drawing practices. Little need be said to those already familiar with this book of its value to the engineer and draftsman. With its revision to fulfill modern requirements engineers and students alike will benefit by having a copy.

RUNNING A MACHINE SHOP, *by Fred H. Colvin and Frank A. Stanley*, 449 pages, $3.50. Published by McGraw-Hill, New York.

This is a new book by the authors of the famous "American Machinists' Handbook." It is especially timely now when every machine shop in the country is taxed to capacity. Chapter headings are: modern machine shop practice, planning a shop, shop equipment, shop transport and material handling, toolrooms and tool cribs, work in the shop, estimating, apprenticeship and training, management, foremen and personnel relations and inspection systems. This basic authoritative book should be of value to all machine shop supervisors and owners.

NAVIGATION OF AIRCRAFT, *by Commander Logan C. Ramsey, U.S.N.* 230 pages, $4.50. Published by the Ronald Press, New York. Revised edition.

First brought out in 1929, this book has had a considerable sale and is now revised thoroughly. In his preface the author points out that airline navigation is dependent upon radio signals which would not be available in time of war, and that knowledge and practice of dead reckoning and celestial observations should be pursued by all pilots who have been riding the beam.

The book has these divisions: introduction; maps, instruments and accessories; dead reckoning; piloting; aerial astronomy; practice of navigating aircraft; and aerology. Numerous tables and illustrations add to the value of the book. Included with the price is a second book called, "Air Pilots' Dead Reckoning Tables" which runs to 48 pages and which is a working supplement to the text.

ENGLAND IS MY VILLAGE, *by John Llewelyn Rhys*, 198 pp. Published by Reynal & Hitchcock, $2.00.

This collection of short stories by an R.A.F. pilot differs from the books by airmen which have been coming off the press rather regularly of late. For one thing, John Llewelyn Rhys is primarily a writer, and again, this is not a factual recital of battle, but short impressions in fiction form. The author fought with the R.A.F. and when he was killed in active service in August, 1940, England lost not only a pilot, but a writer of promise. The present volume comprises excerpts from the two books he had published, as well as short stories, and apparently his wife, who edited it, considers them representative of his best work. They are well-constructed and sensitive, revealing not only a keen love of flight, but a realistic appreciation of fear and danger. Somewhat disturbing is the repetition of several phrases and descriptions which might have been avoided through editing. A tribute to the book is the fact that on finishing it one is very anxious to read his previous works.

HANDBOOK OF INDUSTRIAL FABRICS, *by George B. Haven, S.B.*, in Charge of Textile Research, M.I.T. Published by Wellington Sears Co., New York, N. Y. 790 pp. $2.00.

Revised and enlarged, this important handbook has gone into its third edition, and should prove of continued value to engineers, purchasing agents and salesmen, for whom it is written.

Among the considerable number of changes and improvements, Chapter VIII has been almost completely revised to give effect to the new A.S.T.M. specifications of textiles as approved during 1940. This is followed by a rather complete bibliography of selected government publications regarding textiles. In addition to over 700 tables, the book contains numerous photographs depicting various operations, machines, textile products, etc.

MODERN FLIGHT, *by Lloyd P. Clevenger*. 294 pages, $2.95. Published by Noble & Noble, New York.

This is a large, well-illustrated book which should be of value to flight students. It covers all phases of elementary flying, the intermediate stage, advanced acrobatic stage and many phases of advanced flying. An appendix covers motors, aviation occupations, and requirements for air corps, navy and C.P.T.P. flying. Clayton Knight did the illustrations which add a great deal to the book.

LESSONS IN ARC WELDING, published by the Lincoln Electric Co., Cleveland, Ohio. 176 pages, 50 cents. Second Edition.

Due to the popularity of this volume it has been brought out in a second edition. The book consists of 60 lessons, covering all phases of arc welding. The objective of these lessons is to present in a concise manner certain fundamental facts of welding, knowledge of which will enable welders to use the process successfully and economically. It is complete and authoritative and is an excellent "buy" at 50 cents.

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With Kapok Unisorb* Noise Reduction Felt

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In bombers or light planes—depend on Shell Aviation Gasolines for quick starts, instant throttle response, long cruising range. No wonder airport operators, from Newfoundland to Florida . . . from the Atlantic to the Pacific, are stocking fast-selling Shell Aviation Products. Investigate! Address: Shell Oil Company, Incorporated, 50 West 50th St., New York, N. Y., or 100 Bush Street, San Francisco, Cal.

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CONSOLIDATED HEAVY LONG-RANGE BOMBERS B-24

These new "Liberators" and all other Consolidated ships are fueled and lubricated with Shell Aviation Products

Harvey Williams

(*Continued from page 35*)

needed. Will you force them to participation by curtailing the supply of raw materials available for non-defense production? Or through a local defense production official, will you educate and persuade them to do their part willingly?

There are those who do not know what they can do—so they have done nothing. Shall they continue to do that—maybe keeping a plant idle which was closed for economy several years ago?—or will the need and means of their participation be carried to them?

There are those who cannot leave their own doorsteps to find out what they can do, no matter how willing. They are men whose concern with management of their businesses is so continuous and intimate that days (or funds) for trips to prime contractors, district procurement offices, Washington and elsewhere cannot be taken.

What then, is to be done to secure the participation of these three groups—those who won't, those who don't know how, and those who can't leave their plants to find out what they can make? Isn't the simple practical answer "*Take the defense production program to their doorsteps. Show them what to do and sell them* on the need for doing it, at once"

In any nation-wide, spread-the-defense-production plan, these two fundamentals must be faced, met and solved. Decentralization becomes a necessity. Practical, current knowledge of local production capacities and abilities becomes a primary requirement, followed by an effective procedure for coordination between potential subcontractors and prime contractors. With these is the continued need for sales effort, promotion, public relations or persuasion, by whatever name called, to develop the interest and participation of laggard managements.

These principles have been applied and these problems met with success in the plans tested in Massachusetts and Rhode Island. Let us see how they are organized and how they work in the field.

1. *Decentralization* is secured by the division of an area into natural, compact production districts. In each a prominent, respected local man is selected as local defense production coordinator. Regional industry (the state manufacturers association, for example) sets the boundaries of local production districts with emphasis on close, mutual acquaintanceship of manufacturers. Thus, each district, as far as practical, includes plants and managements used to working together on normal peacetime problems. Compactness of size and acquaintanceship facilities coordination of available productive capacities in several plants of a single area. It makes for short, quick hauls by trucks from plant to plant. It makes frequent telephone contact from the local district office to each plant quick and cheap—an essential to maintaining current knowledge of idle productive capacities and to coordinating local plants and prime contractors' requirements speedily.

The local coordinator, selected by industry for his accomplishments, knowledge and ability, provides leadership in his district—to persuade managements to participate or increase participation in defense production, to implement contacts between prime contractors and appropriate plants, to maintain current knowledge of idle productive capacities available for suitable work. To aid him to do "leg-work," an executive assistant, intimately familiar with local industry, is needed—perhaps the secretary of the local chamber of commerce or manufacturers association, perhaps a young executive or engineer from a local plant. For a district above usual size, with 150 active plants in it, two or three stenographers have been found adequate added personnel to service the area well.

2. *Knowledge of Production Facilities* is developed from the various inventories of machine tools and other production equipment already made by many state agencies, manufacturers associations, the National Industrial Council and others. These are consolidated into a single local district "bible" of productive facilities. New inventories are requested only from those who have not participated in former ones and who have *idle productive-machine hours* which may be used on defense work. No useful purpose is served by asking busy managements of plants with a large backlog, to provide inventories of production equipment that will be in continuous multi-shift use for months. Needed, useful data is that on idle or partially idle equipment.

3. *Knowledge of Current Production Capacity* is secured by a weekly telephone check of each plant in each local district to discover available time on idle or partly idle equipment. It is expressed in machine-hours available for the following week on each type of machine involved. For machine tools, it is tabulated on a form, keyed by numbers. Field operation has demonstrated the ability of stenographers, without machine tool knowledge, to collect the data from plant managements and compile weekly summaries of it. Distributed to nearby prime contractors such data on machine tool capacities brings quick response, an inquiry for details, a check with plants having the desired type of capacity and often the arrangement of new subcontracts within hours after the new weekly available-machine-hours-data has been released.

4. *Education* is aided by meetings of industry, radio broadcasts by prominent personalities and such high-powered but infrequent public relations work. An idea is best sold by continued, steady, on-the-ground work or by example. Here is a great usefulness of the local production district leader — ferreting out the plants and shops which can but are not participating in defense work to the limit of their capacity—making examples of local companies that have successfully undertaken new defense work.

5. *Coordination between potential subcontractors and prime contractors* is implemented by the local production district leader, but again experience in the field indicates the helpfulness of regional offices, each aiding 25 to 30 districts. Regional offices attempting to cover larger areas (more than about 7 500 sq. mi.) seem unlikely to develop the needed intimacy of acquaintanceship with industry in their regions (unless industry is thinly scattered) and it seems improbable that they can act with the speed necessary to meet the demands of prime contractors.

Each regional office requires the guidance of an executive thoroughly acquainted with industry in his area and capable of commanding the cooperation of the local production district leaders. He may be an officer of a state manufacturers' association or an industrial executive, but he must be a "spark-plug." He will need an executive office assistant, about three cruising field engineers and a small stenographic staff. His office should contain a copy of the Production Facilities Inventory of each local district in his region and should receive weekly a copy of the Production Capacity Available Report in available machine-hours from each district. Prompt, satisfactory results depend on (1) the ability of local and regional leaders, (2) their energy and (3) their intimate, detailed knowledge of their area.

Subcontractor — prime contractor coordination frequently starts in the regional office by an inquiry from the prime contractor who submits blueprints or defines the character of productive facilities he seeks. Telephone calls to local district leaders in areas where such type of capacity may be available start local check-ups and result in return phone calls and appointments. Within a few hours, a cruising field engineer from the regional office leaves for scheduled calls at district offices to join the district leader or his assistant and to

visit potential subcontractors already checked as capable—equipment-wise, management-wise and financially—and available to handle a part of the job on hand. Blueprints are submitted, productive capacity and ability is checked by the field engineer. Often, the potential subcontractor is shown how he can do something he has not realized he can do on his machinery. The proper contact at the prime contractor's office is provided. The field engineer goes on. Daily reports to the regional office, with a copy to the district office, keep regional and district leaders posted and provide a basis for discussion with the prime contractor's representative when he arrives to personally inspect *selected facilities* and negotiate subcontracts.

Such a course of action is current day-to-day experience in Massachusetts where a program initiated in the late spring of 1940 was revised to embody the above methods with the encouragement of the War Department, in February 1941. The efficacy of the local production district plan has been demonstrated by the results.

Having outlined the five elements of a plan to put maximum production facilities to work in minimum time, let us examine how they have worked in use.

The Rhode Island Industrial Commission has made a comprehensive test of the weekly analysis of available productive capacity by collection and summarization of machine-tool hours available and unused. This plan, conceived by the Commission's chairman, Mr. William S. Allen, was put into operation on Feb. 8, 1941. Its details were developed by Mr. Arthur J. Minor, Engineering Secretary to the Commission and carried out under supervision of Mr. Clifton Lovenberg, the Commission's Executive Secretary. A "Machine Tool Schedule" is secured from each participating plant. Fifteen basic classifications of machines are included as follows: bending, boring, broaching, cutting off, drilling, gear cutting, grinding, lathes, milling, planing, presses, screw machines, shapers, tapping, special equipment or services. Under each classification are from 2 to 25 subclassifications. All together 115 subclassifications of machine tools are listed. Spaces are provided for additional sizes or types where needed. Each subclassification is keyed with a number. Through this form, Rhode Island has developed the second of the five above-mentioned components necessary to well organized, country-wide subcontracting, namely *knowledge of production facilities*.

Through a second form, "Available Weekly Machine-Hour Capacities," Rhode Island has obtained the third component above mentioned, *knowledge of current production capacity*. The list of machine tool classifications and subclassifications in this is identical with that in the first form. Opposite each type (and its key number) are entered the hours available for the coming week on each type of machine in each plant. This data is secured each Thursday by a stenographer who telephones a designated man in each plant, who has before him a copy of his "Machine Tool Schedule" and "Available Weekly Machine-Hour Capacities," both as previously supplied to the commission by his company. As he runs down the list of his equipment on the "Machine Tool Schedule," he tells the commission stenographer what number of hours will be available for new, added production on each type of machine tool during the coming week. He refers to the types by their key numbers. As he gives the data, the stenographer enters the hours (as does he) on the "Available Weekly Machine-Hour Capacities" form. This contains data for eight consecutive weeks in parallel columns. Thus it serves both plant management and the commission as a continuous record of the plant's activity. Incidental to its purpose of organizing knowledge on available machine tool capacities, this procedure has directed attention of plant executives to proper scheduling of work to keep all machines busy. Benefits to production through more intelligent plant operation result.

Starting with a dozen participating companies, the number has grown to approximately 150 currently. Thousands of machine-hours have been put to use. With general use and distribution of such data through a nation-wide program, greater results can be expected.

Rhode Island has demonstrated the practicability of dealing with *machine-hours available* as a means of keeping abreast of rapidly changing production conditions which make static inventories of machine tools obsolete except for basic data as to character of plant.

Meanwhile, Associated Industries of Massachusetts, with the cooperation of the Massachusetts Development & Industrial Commission and with enthusiastic support from Governor Leverett Saltonstall, modified its program launched in May, 1940, to adapt the small, local production district plan, as above mentioned.

Associated Industries of Massachusetts was founded in 1916. It is the second largest state association of manufacturers in the country with approximately 1,500 members. In all defense work, AIM early took the lead in Massachusetts with its President, John E. Tinsley, accepting the chairmanship of Governor Saltonstall's Industrial Committee for National Defense, appointed in May 1940. Before the close of that year, under the direction of Roy E. Williams, A.I.M.'s general manager, and chairman of the State Manufacturers Association Group in the National Industrial Council, a most comprehensive effort to increase defense production had been undertaken. A special survey of 600 plants capable of making aviation parts and materiel was made, at the start. This was followed by surveys of 1,200 small manufacturing plants and machine shops and a major study of idle manufacturing space made in cooperation with the Massachusetts Development & Industrial Commission. Meanwhile, Massachusetts was divided into 14 districts, each with a "Coordinator", to aid these activities and to enlarge defense production and subcontracting.

Against such background of experience and accomplishment (at the close of 1940, Massachusetts industry had received defense contracts amounting to $868,545,091.43), AIM and the Massachusetts Industrial Committee for National Defense revised its program in February, 1941, to test the decentralization of production organization above described.

Massachusetts was divided into 38 local production districts shown on the accompanying map. Each district is a normal, industrial trade area. Within each, shorthaul trucking will reach every plant. The longest possible haul from the center of the largest district to its borders is only about 20 or 30 miles.

A "Coordinator" for each district was appointed by Governor Saltonstall—without exception the leading industrialist of the community. An assistant coordinator was selected and a local office established. Inventories of productive equipment were perfected within each district, copies being centralized at the AIM office in Boston, in addition to being retained in the local district office. AIM and Massachusetts Development and Industrial Commission engaged three field engineers and created jointly a regional office to aid and encourage the work of the local district offices and local coordinators.

This structure had been created and was in operation by early March, 1941. Some specific examples of its work will illustrate its effectiveness.

A General Motors subsidiary seeking subcontractors for ordnance parts calls Mr. Williams at Associated Industries' offices in Boston. Three local coordinators of districts where appropriate machine tool facilities may be available are called by telephone the morning the inquiry is received. Seventeen prospective subcontractors are located. Within 24 hr. blueprints are at hand and a field engineer leaves to visit each local district on appointments made by local

coordinators with each potential subcontractor. With each of them, the blueprints are examined. Parts which each might make are selected. The field engineer requires three days to complete all appointments but each evening reports are dispatched to the AIM regional office. On the second day, the G. M. representative arrives in Boston. He examines the field reports already received. By telephone, through local coordinators, appointments are made for him with the potential subcontractors indicated as able to undertake work. He leaves to make these calls. In two days he has seen all of those companies which the field engineer and the local district offices have developed as practical sources for the desired parts. He has wasted no time in preliminary hunting for sources or with unqualified plants. In 48 hr. he is on his way back to his headquarters with full knowledge of what he can obtain in the 38 districts of this region. In a few days actual subcontract negotiations are in progress.

A manufacturer of small arms advised AIM of an urgent need for added jigs and fixtures. In one local production district nearly a score of concerns, including small shops, were contacted in a few hours through the local coordinator's office and appointments made with each for the following day. On the following day, an engineer from the small arms company and a field engineer from the regional office visited the district. Within 48 hr. the required jig and fixture work had been placed with four plants.

A firm of naval architects contacted the AIM regional office for facilities to machine shafts 24 in. in diameter and 22 ft. long. By telephone local district offices located six companies capable of doing such work in a few hours. In a day and a half a field engineer visited each, examined equipment, discussed blueprints and arranged for four of the six to submit quotations to the naval architects.

An unusual case is that of a naval station, engaged in the construction of navy equipment, which desires to find subcontractors for approximately 9,200 items. The productive facilities inventories of all 38 districts have been submitted by the AIM regional office. Navy engineers are selecting from over 2,000 plants included, those that have the types of production equipment necessary to make various items. The names of such concerns are sent to AIM which checks through the local coordinators to find out what capacity is available in each plant designated by the Navy engineers, whether each is considered capable of working to Navy requirements and financially able to undertake such work. Where capacity is available and other qualifications are satisfactory, appointments are made for an executive, an estimator and the production manager to call at the naval station, review the work in question and negotiate for its execution. By this procedure, the Navy avoids wasting time in sending its engineers into the field, in dealing with unqualified concerns or visiting plants where productive capacity is already occupied.

Many more examples of the effectiveness of this plan of decentralized production organization may be cited. Currently, Massachusetts industry has a backlog of over $1,000,000,000 of defense prime contracts and subcontractors are conservatively estimated by AIM to have a backlog of twice that amount.

Frequently, it is now unnecessary for a field engineer to visit the local district as it is possible to transmit sufficient data by mail and telephone for the local coordinator's office to do the necessary investigative work to establish relationships between qualified potential subcontractors and prime contractors.

Emphasis should be placed on the success of this plan in taking defense work *to the doorstep of the smaller manufacturers* and to those who have not known how to participate in the defense program. To this can be attributed a substantial increase in the number of subcontractors and of the subcontracting backlog during the last six months. Of particular value is the saving in time to prime contractors' engineers and procurement officials of the Army and Navy in locating *qualified* subcontractors.

At the present, the "available machine hours" method of keeping current records of available production capacity is being developed in the local production districts of Massachusetts. This will increase the efficiency of the program and simplify the work of the local district coordinators and field engineers in finding plants capable of absorbing prime contractors' requirements, promptly.

Such decentralized organization of defense production and subcontracting follows a pattern similar to that which has been successful in handling the Selective Service Act. Local draft boards are familiar with the circumstances of draftees in their districts and are able to administer their local part of the draft program fairly and efficiently in a manner that would be impossible through regional offices handling large areas.

No practical obstacle prevents the nation-wide application of the local production district plan, proven in Massachusetts, or the method of keeping abreast of currently available productive capacities, proven in Rhode Island. The prompt organization of such a program throughout the industrial areas of the country will bring defense work to the managements of plants with idle or partly idle equipment. It will provide prime contractors with a *uniform method* of locating subcontracting facilities wherever they are sought. It will save much valuable time for prime contractors and procurement officials. It will provide to those administering defense production the same comprehensive, intimate contact with industry—large and small—that those administering the draft have with local groups of draftees. By such a pattern, applied uniformly throughout the United States, the need for participation in defense production can be brought to every shop and plant—work can be placed upon "that 50 percent of this country's machine tools which are either idle or working less than eight hours per day." There will be no need for owners to sell them, destroying their production capacities and eliminating from the community tools on which local labor has earned and should earn its wages. Better far to put these tools to work where they are—an objective which only requires intelligent, aggressive organization for its accomplishment.

It is high time that such a country-wide plan of uniform, thorough organization for maximum defense output be organized aggressively by industrial executives of proven ability familiar with the practical problems of prime contractor—subcontractor coordination, with the need of selling managements on undertaking defense production, with the problems of introducing new, unfamiliar products into varied industrial plants, and with the objective of preserving and utilizing all of the valuable progress, knowledge, experience and trained personnel which exists today in local and state organizations.

Window Shopping

Fiberglas Standards—Interesting manual on glass products used in general for acoustical and thermal insulation. Made of inorganic non-absorbent, incombustible fibers which possess extreme flexibility and tensile strength. Fiberglas is light in weight, clean and unharmed by salt or fresh water. Owens-Corning Fiberglas Corp., Toledo, Ohio.

Victor Welding Equipment—Catalog of an established firm presenting detailed and illustrated descriptions, specifications and prices of welding and cutting equipment. Covering highest type metals to heaviest metal thicknesses. Victor torches meet every possible choice of operating need. Victor Equipment Co., 844-54 Folsom St., San Francisco, Calif.

R-B-M Catalog—Detailed descriptive and technical data of electric switches, relays etc., including a complete description of electrical and mechanical Package Unit made to your specifications. R-B-M Mfg. Co., Division of Essex Wire Corp., Logansport, Ind.

Falk Airflex Couplings—Bulletin No. 3165 containing discussion with example illustrations of the Airflex Coupling "Rubber Shear" principle—dimension drawings and tables of each type coupling. Falk Corp., 3001 W. Canal St., Milwaukee, Wis.

Selig Altschul

(Continued from page 53)

those best suited to make them. Important shortages in the material and labor supply have developed and will probably continue to grow.

For example, Boeing's production of "Flying Fortresses" has been delayed by about 90 days due to the failure of allotments of aluminum to arrive on time to permit an uninterrupted flow of heavy bombers. Aluminum bulks large in the defense effort with the aircraft industry taking over 50 percent of the total armament use. In March, virgin aluminum production totaled 44 million lb with 79 percent going to defense industries. This has been gradually increased to a production of 53 million lb for June with the entire output allocated to defense use. A rapid expansion of aluminum facilities is now underway. The total production of virgin metal for 1940 aggregated about 420 million lb with the current annual rate indicated at about 600 million lb. Present expansion plans contemplate an annual rate of more than 800 million lb by July of 1942. Despite this expansion already provided for, the increased production which has taken place this year has not kept pace with the increase in the military demand—particularly from the aircraft builders.

A serious obstacle to greater production is the lack of sufficient skilled labor. Some relief may be obtainable through increasing the work-week to 48 hr. before overtime commences. Contrary to popular belief, in many instances, it is physically impossible to perform many aircraft manufacturing operations 24 hr. seven days a week.

Along with the growing shortages in the labor supply, the unit labor cost of production has had a tendency to rise. This is primarily due to lower efficiency in supervision, machinery and workers. As the aircraft industry continues to spread itself out more thinly, these conditions are bound to continue and may be greatly magnified.

In the welter of confusion of the ever-expanding armament program, the over-all picture has a tendency to become blurred. New defense plant construction, expansion and equipment since the national defense program was launched a year ago now involves commitments of about 3 billion dollars for more than 1,700 projects. Of this amount the aircraft industry has the biggest participation for a total of $586 million. This is represented by 490 million dollars being borne by the Government with the balance being financed by private industry under the accelerated tax amortization plan. The figures are based on U. S. Government and British commitments through Apr. 30, 1941, and certificates of necessity issued to private industry through May 15, 1941.

Once again it is self-evident that the government is, for the most part, carrying the burden of the present armament program, thus avoiding the tremendous deflation of private capital in expanded brick and mortar during the post-war period.

Appropriations and authorizations for defense materials since June 30, 1940 now aggregate 37.8 billion dollars from the U. S. plus 3.7 billion dollars from the British Empire for a grand total of more than 41.5 billion dollars. The aircraft industry will receive 6.5 billion dollars of the U. S. funds and 1.7 billion dollars from the British for an aggregate of 8.2 billion dollars. This is for the period to Apr. 30, 1941.

Such is the broad perspective of the straining expansion of manufacturing facilities and the attempt to digest a bulging backlog of orders. Yet this is not all as the cry is for more plants and planes. On the way is another War Department supply bill requesting about 9.5 billion dollars. This huge appropriation includes about 2.8 billion dollars for 13,000 additional planes. All told, these added funds are expected to give the Army Air Corps a total of 46,000 planes by the fall of 1943. Moreover, new commitments are expected to complete the Navy's 10,000 plane program. Staggering as these plans may be, no one can foretell the point where a halt will be called to the constantly growing production of the sinews of war.

Translated to the investor, it must be evident that market quotations for aircraft equities have long discounted many unknowns. Despite complicating factors resulting from expansions along with higher costs and taxes, satisfactory profits (not excess profits) will most likely prevail in the aircraft industry. At long last sufficient orders are on hand to warrant tooling up for mass production permitting a sustained level of high activity. Profit margins, albeit reduced, are expected to return sufficient earnings to equity capital, for the most part, to bolster market values in the aircraft group.

In the midst of the feverish activity to produce military craft, comes word of the development of a new high speed 64-passenger transport with 40 of the planes on order for Transcontinental & Western Air. Many outstanding claims are advanced for this plane. Pan-American Airways has also ordered 40 planes of a similar type. Called the "Constellation", these planes are to be built by Lockheed Aircraft Corp. and the Priorities Board has authorized construction to proceed on three, the first of which is scheduled for delivery next spring.

Removing the glamorous aspects of this announcement, what are the practical realities of this development? It may be well to recall the early case history of the Douglas DC-4. In March, 1936, a contract was signed for the completion of this prototype by April, 1937. It was not until May, 1939—two years later—that a satisfactory DC-4 model was developed. The "Constellation" may also take more than the contemplated one year—especially with a war going on.

Have any commitments been made by TWA to purchase these planes? Evidently not. Such a commitment would involve about $20 million. The total assets of TWA were last reported at about $10 million—with very little of this amount available for new equipment purchases. No report filed with the SEC or CAB or issued to stockholders shows any obligation to make such acquisitions. Most likely, Lockheed may look to Howard Hughes—TWA's largest stockholder—for financial responsibility in this respect.

Pan-American Airways, on the other hand, in its 1940 annual report plainly states that it has ordered a total of 40 four-engined aircraft of advanced design—unquestionably referring to the Lockheed "Constellation" model. Moreover, Pan-American takes cognizance of this commitment in a foot-note to its balance sheet.

Forty of these planes would give TWA an aggregate seating capacity of 2,560. The company's present equipment has a "practical" estimated seating capacity of about 750. Air transportation is unquestionably growing but TWA may have difficulty in closing this indicated gap—especially with the "Constellation" presumably being adopted for long-distance flights.

Vision of future possibilities is a prime requisite in commercial aviation. What may appear fantastic today may become a reality tomorrow. However, all new developments must be examined in their proper perspective and it is in this light that the foregoing presentation has been advanced so that a realistic appraisal may be made.

Barron's Stock Averages

	Air-craft	*Air transport*	*50 Stocks*
June 6, 1941	35.58	19.16	67
May 29 1941	35.02	18.81	66
23 1941	33.98	18.91	66
16, 1941	33.98	17.88	66
9, 1941	34.83	18.59	68
June 7, 1940	37.85	24.22	66

Franklin Engines

(*Continued from page 57*)

are attached to the crankcase by means of flanges on the barrels and eight studs and nuts. One inlet valve and one exhaust valve of the overhead type are provided in the cylinder head where they are actuated by push rods from camshafts supported in steel-backed babbit-faced bearings The exhaust valve seat is an insert of stainless steel Friction dampers are fitted on the valve springs and Wilcox-Rich hydraulic valve lifters are used on the push rods to ensure accurate functioning at all speeds The valve clearance is 0 040 in with no oil in the lifter and the latter fully depressed. The valve operating gear is totally enclosed

Carburetion is provided by Marvel-Schebler MA-3 up-draft carburetors Four carburetors are used on both engines with suitable size jets to meet the needs of the particular engine. The carburetors are flange-mounted on the under side of the oil sump with individual induction pipes leading to the cylinders On the 8-cylinder engine each carburetor supplies 2 cylinders while on the 12-cylinder engine 3 cylinders are connected to each carburetor

The lubrication system consists of an oil pump located at the bottom of the engine with an extension into the oil sump which gives forced feed lubrication to the main bearings, the connecting rod bearings, the hydraulic valve lifters and the valve mechanism Other parts of the engine are lubricated by splash An oil pressure of from 35 to 45 lb per sq in is used

The accessories are grouped neatly at the rear of the crankcase Two Bendix-Scintilla or Eisemann magnetos and a 12-volt Auto-Lite electric starter are standard equipment Provision is made for mounting an electric generator, and a mechanical fuel pump and shielded ignition can be fitted if desired The spark plugs are Champion The mounting brackets are provided with rubber shock rings which give the equivalent of floating power.

Aircooled Franklin 8AC-398

Type Eight cylinders, air cooled, horizontally opposed, direct drive, four cycle.

Bore and stroke	4.25x3 50 in.
Displacement	398 cu.in
Length and area	50 2 in x2.8 sq ft.
Power output	200 hp for take-off 170 hp for cruising
Total weight (dry)	365 lb
Specific weight	1 82 lb./hp.
Fuel consumption	0 48 lb /hp./hr
Oil consumption	0 003 lb /hp /hr
Compression ratio	7 0 1

Aircooled Franklin 12AC-598

Type Twelve cylinders air cooled, horizontally opposed, direct drive, four cycle.

Bore and stroke	4 25x3.50 in
Displacement	596 cu.in
Length and area	6 3 in x2 8 sq ft.
Power output	300 hp for take-off 255 hp for cruising
Total weight (dry)	250 lb.
Specific weight	1 50 lb./hp
Fuel consumption	0 48 lb./hp /hr.
Oil consumption	0 003 lb./hp./hr
Compression ratio	7 0 1

Electric Power Aloft

(*Continued from page 52*)

the temperature of the engine oil These are intermittent-duty motors There may also be a booster fuel pump driven by a motor and a motorized propeller de-icing pump These would be continuous duty motors This type of airplane might also have a motorized antenna reel

On multi-engined airplanes, both large and small, in the commercial field, motors are generally required for landing gear and wing flaps In the large ships there may be such other motorized devices as cowl flaps, trim tabs, booster fuel pumps and propeller de-icing pumps It is in the large military aircraft, however, that the usefulness of the electric motor becomes apparent As the electrical system is probably less vulnerable to gun-fire than the hydraulic system many mechanisms which might be operated hydraulically on commercial ships are electric-motor operated in military planes Furthermore, some of the bombers are so large that many of the functions must be handled electrically which would be operated manually in a smaller ship In addition to all the applications referred to above there are bomb releases, power-operated turrets, forced draft fans, condensate pumps, refrigerators, parachute flare releases, ventilators and bomb hoists On flying boats there would also be float locks and anchor winches. On extremely large airplanes there may be twenty or more electric motors ranging in size from 1/100 hp to 5 hp.

The trend is certainly toward increasing the number of power operated accessories As airplanes become larger and more complex remote control of many functions becomes a necessity Perhaps rudder, ailerons and elevator will some day be actuated by a motorized mechanism analogous to the steering engine aboard ship Undoubtedly the plane of the future will require many more motors than present-day aircraft

As is the case with all machinery electric motors require adequate maintenance Series and shunt motors, having carbon brushes and commutators, require replacement of brushes at various intervals The length of brush life varies widely with the nature of the application and the conditions under which the motor is used. It is good practice to disassemble the motor, remove accumulated carbon dust and dirt and turn the commutator if possible when brushes are replaced

One topic which is receiving considerable attention in the aircraft industry today is standardization The advantages of course are faster production and lower prices, but these may sometimes be outweighed by gains in compactness and light weight which are often effected through the use of motors specially designed for a particular application Electric motor manufacturers would welcome standardization as a means to reduce their production and design problems Aircraft manufacturers would doubtless welcome it since it would make it possible for them to obtain large quantities of motors in a short time.

Several agencies, including the SAE, the Air Corps Materiel Division, the National Aircraft Standards Committee and the Western Aircraft Standards Committee, are working towards standardization of aircraft, and aircraft parts They will probably include electric motors in their work. The impetus which the National Defense Program is giving to this work through its need for mass production should be beneficial Standardization would make it possible, for example, for the aircraft manufacturer to specify a cowl flap motor, knowing in advance the essential dimensions, performance and weight. He could be reasonably sure of obtaining delivery within several weeks or less

The manufacturers of electric motors are carrying on intensive research work aimed toward making aircraft motors smaller, lighter and more dependable. Such work includes investigation of inorganic insulating materials capable of withstanding very high temperatures, for the higher permissible temperature rise, the more power may be taken from a given frame size It covers also alloy steel permanent magnets by means of which it is possible to eliminate field coils and thereby reduce size and weight. These and other projects designed to make the use of electric motors on aircraft more convenient and practical, are being carried vigorously forward The future will undoubtedly see many important advances in this field

Air Express

(*Continued from page 33*)

ness in April, 1939, was only approximately 14½ percent of the shipments although it produced almost 27 percent of the revenue. Value charges of 10c per $100 are exactly the same for air express as for rail express.

Figures for the fiscal year 1940 show that the air lines revenue was 51c per ton-mile of passengers (gross revenue), 58c. per ton-mile excess baggage (gross), $1.96 per ton-mile of air mail, and 60c. per ton-mile of air express after deducting the agency's expenses.

Air express has inaugurated special commodity rates for newspapers and racing forms and is making an experiment of special commodity rates for a limited period in certain territories. For example, cut flowers may be shipped from Portland, Ore., to Minneapolis, Minn., at a marked reduction in cost at present. If the principle of special commodity rates proves successful, it may be expanded nationally to increase gross revenue. The experiment is being watched with interest.

Air express is largely a small-weight traffic, averaging about 7 lb. a shipment with an average charge of approximately 40c per pound. It is seldom realized, however, that almost half of the total air express revenue is on shipments over 10 lb., averaging over 30 lb. in weight, although they constitute less than 12 percent of the total number of shipments, as shown on the accompanying table. Another fact to be noted is that on 25 percent of the shipments the gross revenue is over $1.36 per pound.

A breakdown of the air shipments into weight groups for a typical month shows:

	Percent of Total shipts.	*Percent of Total Revenue*	*Average Weight*	*Gross Revenue per pound*
1 lb. or less	25.3	9.5	74 lb.	$1.365
Over 1 lb., not over 5 lb.	49	29.5	2.68 lb.	598
Over 5 lb., not over 10 lb.	14.2	17.4	7.11 lb.	412
Over 10 lb.	11.5	43.6	30.60 lb.	332

By and large, there is little difference in the out-of-pocket ground cost for handling big and little shipments. The same amount of work is involved in management, pick-up and delivery, transfer, billing and the other details of ground operation. Western Union is used to pick up and deliver many of the small shipments. Obviously both the air and express companies are after "bigger and better" shipments. There is a distinct trend in that direction. Last year shipments increased 23 per cent but the revenue increased 27 percent and the weight 31 percent.

A study made for April, 1939, showed the following:

AIR EXPRESS COMMODITY GROUPINGS*

Commodity	*Percent of Total Shipts*	*Wgt*	*Charges*	*Avg. Wgt (lb.)*
Machinery hardware including aviation, auto tires, electrical, misc. machinery hardware and oil supplies	17.61	26.69	23.33	9.1
Printed matter, including prospectuses, P/M Adv., books, paper products, newspapers, racing forms and magazine proofs	17.83	25.66	18.73	8.7
Store merchandise including textile, samples, uniforms, wearing apparel, shoes, hats and furs	13.59	11.55	14.06	5.1
Moving picture films	4.71	7.41	9.29	9.5
Electros	6.92	4.86	5.29	4.2
Valuable papers	6.82	3.96	4.94	3.5
Cut flowers	3.20	2.66	3.48	5.0
Valuables, including bank checks, gold and currency	5.20	3.41	3.29	3.8
Miscellaneous, including paintings, live insects and misc. merchandise	2.71	2.97	3.14	6.6
News photos	6.04	1.28	2.72	1.3
Drugs, etc., including drugs, serums, cosmetics and surgical instruments	2.26	2.02	2.15	5.4
Phonograph records	2.77	1.52	1.97	3.3
Freight manifests	3.47	1.57	1.97	2.7
Jewelry	2.63	.91	1.61	2.1
Food	1.00	.96	1.04	5.8
Optical & camera	1.08	.81	.97	4.5
Raw samples	1.12	.52	.81	2.8
Office supplies	.63	.61	.59	5.8
Personal baggage	.17	.44	.36	15.1
Liquor	.23	.19	.26	5.1
Total	100.00	100.00	100.00	6.0

Air express is flown by 17 major air lines over 45,000 miles of airways between more than 250 airline cities in the United States. During a test month 29 percent of the *forwarded* revenue was on shipments from New York State, 18.2 percent from California, 10.95 percent from Illinois and 5.02 percent from New Jersey, while 20.86 percent of the *received* revenue was on shipment to California, 16.41 percent to New York, 8.11 to Illinois, 6.52 percent to Florida and 6.18 percent to Texas.

*The Express Agency is making an abridged analysis for April, 1941.

Railway Express Agency coordinates the more than 250 airline cities of the country with 23,000 off-airline towns and cities. At present approximately 30 percent of all air express shipments either start or finish or move part way by rail. The movement by rail to expedite delivery is a considerable portion of this during some months. The heavy industries, such as aviation, automobile, rubber, machinery and hardware, provide the lion's share of the off-airline business. During a test month, the heavy industries amounted to one-third of the total number of off-airline shipments, produced nearly half of the off-airline revenue and averaged $4.21 a shipment, or about 60 percent higher than the "on-airline" shipments for that month. States that produce off-airline revenue in forwarded shipments are New York, Illinois and California, states that receive most are California, Texas, and New York. Month after month southern New England (Providence to Stamford) provides more than 10 percent of the nation's off-airline shipments. Off-airline air express volume is increasing at a faster rate than between airport cities. In February, 1941, this volume increased 63.9 percent in shipments and 93.8 percent in revenue compared with February, 1940. On-airline population in 1940 was 41,460,000; off-airline, 90,209,275.

In addition to its domestic service, the Express Agency extends air express to 47 countries and colonies through an international air express contract with Pan American Airways signed in August, 1934. The agency prepares the Pan American airwaybill (which has space for 62 entries), examines and takes up the necessary export papers, then moves the shipments and papers by rail or air to international airports.

On inbound international shipments the agency receives air express from

Pan American at the ports of entry and either trains or flies them to their destination sometimes in "bonded service." The agency is designated by the United States Treasury as a bonded carrier and its employes are familiar with the detailed requirements connected with handling "in bond" shipments as well as the penalties for infractions.

In 1940 there were 109,396 international shipments, an increase of 37.9 percent over 1939. Domestic charges on these swelled 45.7 percent.

An air express edition of 20,000 copies of *Time* for Central and South America was inaugurated with the May 5, 1941, issue of the weekly magazine—at a three-week saving in time. Announcement of the service met with wide acclaim. Later, it was said, the magazine would issue an edition to be air expressed to the far corners of the earth.

The direct costs of handling air express on the ground may be broken up roughly into out-of-pocket expenses that are pooled and deducted from gross revenue, which expenses include advertising, insurance, loss and damage, pay of drivers and other employees, vehicle expense, taxes, Western Union service, printing and stationery and miscellaneous. In general, many other ground expenses including selling, handling of claims, etc., are borne by the Express Agency as part of its service for the 12½ percent of the gross revenue retained after out-of-pocket expenses have been deducted.

The two major out-of-pocket expenses are advertising and labor. The advertising budget has been set from year to year by the air companies, with a steady increase in appropriations. Labor costs have not shown an appreciable decrease per shipment even though the volume has increased. This probably can be accounted for because the special service given on pick-up and delivery of air packages, including Western Union service, is largely individual and consequently does not vary very much with the quantity. The labor cost of transfer between city and airport may eventually decrease per shipment with volume increase, but no decided trend in this direction has been apparent, because with increasing flying schedules, more transfer trips were made, thus leaving the average load per trip about constant. The vehicle costs vary as the hours of labor of the drivers and the payroll taxes vary in direct proportion to the labor cost. Undoubtedly there would have been a lowering trend in labor costs if rates of pay and taxes had not been so universally increased in the last few years.

Selling air express service, both domestic and international, to the American public has been made part of the daily duty of the agency's 57,000 employees. Educational campaigns for employees stress detailed information—where to look for air express business and how to sell it to prospective patrons. Time tables are published frequently for 54 of the larger cities showing time of arrival and departure of each flight to the more than 250 airline cities as well as the exact cost for the weight of shipment and abbreviated data concerning international air express. These are distributed to thousands of employees and patrons and prospects so they may have up-to-the-minute information on "the fastest way" means air express. Similar information tables have been prepared for employees at off-airline points. To pump enthusiasm into these educational campaigns, air express sales promotional plans are conducted frequently.

Recently Charles A. Fehling, an agency truck driver in New York City, won an air trip to the Pacific Coast for himself and his wife as first prize in a nationwide air express contest. Fehling was quick to take advantage of the lease-lend fight in Congress and the ASCAP-BMI music feud to obtain new air express shipments of radio transcription records.

An air research committee has been appointed by L. O. Head, president of Railway Express Agency, consisting of two traffic, two air men and an accountant to coordinate data made by the agency in surveys it conducted during 1934, 1935, 1937, 1939, and again in 1941.

The 1939 analysis was one of the most comprehensive ever made in the history of traffic. The findings cover 1,000 pages of condensed data bound in three volumes, showing breakdown into 50 weight classifications, 43 commodities, 24 mileage zones, 48 states and 40 principal cities as well as division between on-airline and off-airline business.

The research committee is now compiling information gleaned from interviews with more than 100,000 shippers and prospective shippers, including data on some 50 points relative to rates and service desired for air express or air freight. In cooperation with the air companies, the committee is endeavoring to establish accurate quantitative figures to ascertain how air express can capitalize more remuneratively on the present unused capacity of domestic airline flights to determine the future field for expansion of cargo service.

Stacking Delays

(Continued from page 41)

altitude approximates 12 min. During this time no other flight can be allowed to work the same problem. Hence, even the largest airport becomes limited to approximately five approaches and landings per hour during instrument flight weather. Very often the average is less. An unwieldy system at best when only one flight is concerned, the standard approach breeds its own delays when applied to several flights arriving at the same terminal at close intervals. At major terminals, such as Chicago and New York, scheduled arrivals per hour during the busier periods of the day are many times greater than the capacity of a standard approach procedure can accommodate. The result has been an ever increasing number of serious A.T.C. holding delays. While each flight in order of priority works out its descent problem, all others must shuttle back and forth on the various legs of the range at altitudes sufficiently spaced to insure safety from collision. At one time as many as 27 airline flights were involved in such an A.T.C. stacking arrangement when the Newark airport was used for the New York terminal. A stack of ten or more flights is not infrequent.

Obviously, such a situation creates a fatal bottleneck restricting the smooth flow of airline traffic. In addition it has more serious results. Pilots are unable to estimate accurately in advance the length of delay to expect. Thus either excessive gasoline must be carried as insurance whenever instrument weather appears likely, or a danger of fuel shortage must be risked. Since the former decision is always taken, passenger loads are automatically reduced and needed revenue thrown away. Likewise, the dangers of adverse flight conditions are often increased. Instead of an expedient approach and landing, a pilot may be called upon to hold for long periods in icing or other unfavorable conditions. These can be extremely variable from one altitude to the next and A.T.C. at best can have but imperfect knowledge of the same, or, if a complicated holding situation exists, do little about it. As it is now, such a situation frequently causes a pilot to pass up the terminal and proceed to his alternate. The cause is not the weather but the delay.

Another primary cause for traffic delays as well as confusion has always been the lack of a suitable radio communication channel between A.T.C. and the pilots in flight. At present A.T.C. has no direct means of communication with the flights they are controlling. This is all done indirectly through either the airlines' radio channels, the airport control towers, or the voice facilities of the radio range stations. Applied to airline traffic, the usual course of an A.T.C. message is via telephone to the airline operations office. Here it is written out and forwarded to the radio communications room for transmission to the pilot in flight. Minutes slip past. The advantages of instantaneous communications are lost, and nowhere are they more needed. Likewise, the possibility of mistakes are increased in ratio to the number of people involved in the relay of the message.

There may be many good reasons for the retention of this extremely awkward system of communication. None of them, however, appears to be so essential as to outweigh the tremendous contribution which direct communication would make toward efficient traffic control and air safety.

So acute has become this entire problem of traffic control that it is an encouraging sign to note that some action is being taken to minimize the effects of these basic factors in delay.

Straight-in Descent

One obvious solution for reducing the time required to make a safe instrument approach is to eliminate the need for the standard approach procedure. By placing suitable radio position markers on the appropriate range legs, and at strategic distances from the range station proper, the altitude of an inbound flight can be safely stepped down so that a straight-in descent is possible from the inner marker to the field. Such a plan, properly coordinated, not only can eliminate the lengthy standard procedure but also opens up the possibility of approaches from two directions rather than one.

In modified form, this basic idea of the straight-in approach has recently been adopted at Chicago. Actually only one additional marker has been installed, that being placed on the southeast leg of the range 2.5 miles south of the field. Refer to Fig. 1. This is a very small area high frequency marker (75 megacycles) providing a pilot both an aural and visual signal similar to the Z and fan type markers. For purposes of identification, however, both the aural note and the color of the light are different.

While no approach marker has been located on the northwest leg, a straight-in approach has also been made possible from this direction by using the Wilson intersection (northeast leg of Joliet and northwest leg of Chicago) in conjunction with the range station itself as a marker system to govern descents.

With these changes in the basic control system, instrument approaches and traffic control at Chicago conform generally to the following outline.

Flights over routes from the east, southeast, and south and following the southeast leg of the Chicago range from the Lansing intersection will, if no delay is necessary, be cleared for a straight-in approach to the airport using the Ashburn approach marker. Crossing Lansing at 2,000 ft. sea level, descent is made to 1,610 ft. sea level. Just prior to reaching the marker, wheels are lowered and airspeed reduced to 120 m.p.h. The marker itself is identified first by the aural note and then by the light which lasts approximately 15 seconds (dependent upon receiver sensitivity). With the fade of the visual signal, power is again reduced for descent to authorized minimum altitude of 1,110 ft. sea level (500 ft. above the field level). If contact is not established at this altitude within 1.5 min. past the marker, pull-up is made straight ahead toward the range station to an altitude of 1,610 ft. sea level.

In event of such a missed approach from the Ashburn marker a flight may, if traffic conditions allow, be cleared out the northwest leg for the execution of a standard approach, thus being given two chances to complete a landing in the same space of time as formerly was taken for one.

Flights other than those cleared to approach using the Ashburn marker are enabled to make straight-in approaches on the northwest leg from the Wilson intersection. If en route from the north or northwest originally the procedure is as rapid as that on the southeast leg. Mt. Prospect fan marker provides a convenient fix to be crossed at 2,000 ft. sea level from which descent can be made to 1,610 ft. sea level prior to crossing the Wilson intersection. Thereafter, wheels are lowered, airspeed reduced to 120 m.p.h. and descent continued to 1,400 ft. sea level for crossing the range station. From the range station descent is made to authorized minimums with an elapsed time of 1.5 min. allowed for making contact before pull-up is required. After a missed approach, pull-up is made to the N side of the southeast leg on a ground track of 180 deg. and to an altitude not exceeding 1,610 ft. sea level until instructed otherwise by A.T.C. See Fig. 2.

Arrivals at Chicago via either the northeast or southwest legs of the range are offered little advantage by the new procedure until such time as a traffic hold is encountered. Flights arriving via these legs, which are cleared number one to the approach, conform to the following procedures. From the northeast leg a flight arrives over the range station at the approved initial

approach altitude and then executes a standard approach procedure from the northwest leg. Flights arriving via the southwest leg do not proceed directly to the range station but follow the northeast leg of the Joliet range from Du Page intersection to Wilson, and then let down as described above from Wilson to the airport.

The new let down procedure from Wilson proves most advantageous whenever A.T.C. holds become necessary. Formerly, flights were instructed to hold between the Chicago range station and some point or time interval northwest. Thus when cleared to approach a flight was very often at a disadvantage point on the beam and had to proceed into the range station and then turn around before starting the standard approach procedure. Frequently 15 to 20 min. elapsed between successive approaches for this reason.

When A.T.C. holds are required, all flights cleared to hold at Wilson intersection now proceed to Wilson as described and thereafter maintain a flight path between Wilson and the Mt. Prospect fan marker. The one exception is when a flight is cleared to hold at 2,000 ft., and is designated number two to approach, it shall hold as close as practical north of the intersection so as to minimize delay after being cleared number 1 to approach. This scheme, in effect, maintains the stack-up of holding airplanes (with the usual vertical separation of 1,000 ft.) just north of the Wilson intersection from which the approach can be made straight-in after receipt of approach clearance. Once a flight cleared number one reports past Wilson and leaves 2,000 ft., all other flights are stepped down 1,000 ft. respectively, in preparation for the next clearance. Normally this will be given when the number one flight has made contact over the field, thus indicating an average time interval between successive clearances of 7 or 8 min. rather than 12 to 15.

The new Chicago approach procedures illustrate what can be done to expedite traffic control with a minimum installation of new radio facilities.

Range Control at LaGuardia

At LaGuardia Field, New York, however, instrument approach traffic control has, in theory, been carried to the logical conclusion. Here, under a system termed Range Control, the ideal of the straight-in approach has been combined with an experimental method of direct radio communication between the traffic controller and the pilots in flight.

Cooperating with the various airlines, A.T.C. has allocated a separate office from which all Range Control instructions are sent and received. The Range Control operator and his assistants have at their disposal a complete battery of radio transmitters and receivers so that direct communications may be maintained with all flights under Range Control jurisdiction. In addition, direct telephone communication with the regular A.T.C. office makes all necessary traffic information available to both offices. Likewise an assistant in the airport control tower is in direct telephone communication with the Range Controller to advise of all plane movements on the field or due to take off. A future, permanent set-up contemplates the location of the Range Control office in the control tower itself.

Within the New York area a separate zone or airspace has been designated as under the direct jurisdiction of Range Control. This includes the area on the LaGuardia range between the Keyport intersection (southwest leg of LaGuardia and the southeast leg of Allentown) and the Port Chester fan marker on the northeast leg of LaGuardia. To the west it is bounded by the southwest and northeast legs of the Newark range, and to the east it includes the Floyd Bennett range to a distance of about 3 min. flight time east of the Rockaway approach marker. Vertically, the control extends to and includes the 4,000 ft. sea level altitude between Keyport and the LaGuardia range station, and the 2,500 ft. level between the range station and the Port Chester marker. Refer to Fig. 3. All flights outside of and above this air space will remain as formerly under the jurisdiction of A.T.C.

The operation of Range Control is supposed to conform to the following general procedure. Any inbound flight approaching New York under instrument flight rules from the northwest, west, and southwest will remain under the jurisdiction of A.T.C. until such time as clearance is given to the Coney Island intersection at 4,000 ft. (or lower) and Range Control. Flights from the north and northeast will remain under A.T.C. until a similar clearance or one reading to the Port Chester fan marker at 2,500 ft. and Range Control is received. Upon being cleared to Range Control, a pilot will shift his transmitter and communications receiver to the frequency which his company has set aside for Range Control communication, and upon reaching the designated check point (Coney Island or Port Chester) at the assigned altitude will report directly to Range Control. From this time onward, until geound contact has been made and the tower contacted, or until reassigned to A.T.C., the flight will be under the sole jurisdiction of the Range Controller. Figs. 4, 5 and 6 illustrate the operation of Range Control in diagram form.

Upon receiving a pilot's report at Coney Island, Range Control will furnish the correct time, the Kollsman altimeter setting, the wind direction and velocity on the geound, the runway being used, and the expected approach clearance time.

This system of control is so designed that normally the controller will have a maximum of four flights to superintend simultaneously. Three of these will probably be holding at 2,000, 3,000, and 4,000 ft. respectively south of Coney Island, while the number one is making its approach. When cleared in, this flight will cross Coney Island at 2,000 ft. and holding an indicated airspeed of 120 m.p.h., reach the LaGuardia range station approximately 5 min. later at 1,200 ft. and thence make the final descent to the field. When Range Control has acknowledged number one flight's report of leaving Coney Island and 2,000 ft., number two and three will be instructed to descend to 2,000 and 3,000 ft. respectively. When the 4,000 ft. level is vacant, Range Control will so notify A.T.C., which will clear another flight to 4,000 ft. and Range Control.

Four minutes after number one flight reported starting the approach from Coney Island, number two flight was given approach clearance. In such fashion it is planned that a minimum of 4 min. time separation will always be maintained between flights cleared from Coney Island to the field. In addition, flights holding will be separated by the usual 1,000 ft. intervals.

In the event an approach is missed, flights will remain on Range Control frequency and notify Range Control immediately, proceeding out the northeast leg of the LaGuardia range, and climbing to 2,000 ft. Until further instructions are received the flight will hold between the Port Chester marker and the Clason Point marker at 2,000 ft. In such cases Range Control has several choices of procedure depending upon circumstances existing at the time. Flights may be cleared to the Floyd Bennett range for an approach at Floyd Bennett using the southeast leg and the Rockaway approach marker, or returned to the stack at Coney Island via either the Floyd Bennett or Newark ranges. If it is necessary that the flight proceed to an alternate other than Floyd Bennett it will be reassigned to A.T.C. for instructions.

Flights holding at Coney Island are expected to stay within the airspace between Coney Island and the Keyport intersection to the west of the LaGuardia beam. Refer to Fig. 3.

Since clearances should be expected at approximately 4 to 5-min. intervals, pilots can anticipate clearance times and plan their holding maneuvers in order to be in the most advantageous position when clearance is received.

(*Turn to page 176*)

Recent Books

AEROSPHERE, 1941, Published by Aircraft Publications, New York, N. Y. 900 pages, $10

The second edition of the international aeronautical yearbook, Aerosphere, is an improvement over the first in the arrangement and presentation of its material, and is well worth having.

Incorporating descriptions of most aviation engines and aircraft currently in production, both military and commercial types, it is illustrated by excellent photographs and drawings. The first section is devoted to Modern Aircraft which are described and illustrated in alphabetical order. Preceding this section, is a handy reference article on types of planes used by the Air Corps and Navy, with explanations of insignia and markings identifying the different types.

The second section of the book, called Modern Aircraft Engines, includes information in condensed form on engines currently produced throughout the world. New designs and experimental types available are also described, and the data on these engines are arranged alphabetically according to the country of their origin.

An interesting third section contains statistics of various sorts to which one frequently likes to refer, such as the development of attack pursuit, bombardment, observation and training planes from 1918 to the present, which are illustrated in a series of photographs. Due to the efficient use by the British of torpedo planes, the history of the development of this type by our own Navy in 1917 and thereafter gains particular attention at this time.

Coast Guard aviation receives due attention for its little publicized activities in a recounting of the service from 1916-1940.

The fourth section is a world-wide Buyer's Guide.

RADIO COMMUNICATIONS SYSTEMS. A catalog published by Air Associates, Inc., Bendix, N. J.

This 55-page loose-leaf manual contains specifications, descriptions, and prices on conventional and ultra-high frequency radio communication systems for private, commercial and military operators of aircraft. The book is divided into sections covering long range equipment, school and ultrahigh frequency equipment, interphone equipment, antenna systems, accessories, and equipment for light planes. It is well illustrated with large photographs of each unit described. In addition to aircraft equipment ground station and airport control units are described.

Spotwelding

(Continued from page 42)

aid to welding in that it produces a high contact resistance between the surfaces to be welded and so aids in the generation of heat to make the spot. However, it is so inconsistent in its characteristics that it is found better in most cases to remove it by etching with a dilute acid. Present efforts are being directed toward elimination of hand methods of cleaning and etching in favor of an automatic tank-dip process, and possible substitution of a method which will combine the degreasing and etching operations.

The cleaning of the *outside* surfaces of the sheets being welded is also very important in order to eliminate sticking of the electrodes with consequent burning of spots.

The factors discussed above must all be brought under rigorous control in order to achieve the *consistency* in weld strength which government agencies and careful manufacturers demand in aircraft work.

Other Research Activities

Besides the studies on surface preparation and consistency of welds described above, other interesting fields in which work is being carried on at Lockheed are as follows:

Fatigue Studies—Evidence is being built up to indicate that spotwelded joints compare favorably with riveted joints (especially *flush*-riveted joints) in the matter of fatigue strength under small torsional vibrations such as would be sustained in the airplane.

Measurement of Variables—Methods have been developed for accurately measuring current and pressure during the weld. Reliable knowledge of these variables is essential to further progress in welding technique.

Optimum Spot—Studies are being undertaken to determine whether a few large spots or numerous small spots are most desirable; also on relative merits of short and long times, high and low pressures, transient versus alternating current discharge, etc.

Demonstration of Parts—Much has been done along the line of making up demonstration parts to illustrate to designers the feasibility and economy of spotwelded construction.

Design for Spotwelding

Spotwelding is not technically feasible unless certain simple design requirements are met, such as accessibility for electrodes, sufficient width of flat areas to permit placing of spots, and use of materials approved for spotwelding. (Non-alclad material is not generally so approved.)

Spotwelding is not economically feasible unless certain more broad-gage design requirements are met. The most important of these, at the present stage of development, is use of the "blanket" type assembly—i.e., one in which the structure is made up of a number of units such as skin panels with stiffeners, which can be taken as units to the spotwelders, then assembled with other such units in the jig. It is probable that later on, portable "gun" type equipment will be perfected which will make it possible to weld assemblies in the jigs; but due to the excessive currents and pressures which are required this is not very practical at the present time.

Incidentally, the "blanket" type of assembly is effective in facilitating aircraft construction anyway, even when rivets are used, because it decentralizes activities from the bottleneck at the assembly jig. Jig assembly will probably only come into the economic picture when quantities are such that an entire jig can be wired as one spotwelding electrode and the entire assembly welded by a few descents of a multiple-electrode device such as is used in the automotive industry.

Design for economic spotwelding should of course include long straight runs (parallel if possible) for roll welders.

Economies of Spotwelding

Discussion of the relative costs of riveting and spotwelding has been widespread and contradictory. Where fixed-electrode spotwelders are used on heterogeneous parts primarily designed for riveting, it is often hard to show any net saving as compared to riveting, especially when the latter is of the multiple-operated or automatic variety. However, when parts are designed for spotwelding, work is properly scheduled, and roll spotwelding is used to the utmost, costs can be reduced to a very low level and *production can be speeded up materially*. The latter consideration is very important in our present situation with regard to national defense.

Especially in view of national defense requirements, it is believed to be an inexcusable waste of time and resources for various aircraft companies to duplicate each others' work by keeping their research a profound secret. Of course, there are certain fields, such as aerodynamics, in which a competitive advantage may be gained by secret developments; but in the field of factory practices, equipment, and materials, it is believed that everyone will be the gainer by concerted effort.

Electric Arc Welding

(Continued from page 45)

machines for such work with complete success, achieving the required precision and at the same time considerably reducing the cost of tube cutting over previous methods

Inspection of electric arc welds is largely visual and follows closely gas weld inspection practice The weld itself is usually not quite so smooth, having a characteristic "lumpiness" or irregularity But the inspector has no difficulty in detecting pin holes, unnatural roughness of the weld, burns, or craters All welds in structural members are magnetically inspected for detection of possible hidden cracks. A final air pressure test is given to the completed fuselage structure, testing all joints with soapy water for tell tale bubbles. Under a pressure of 80-100 lb. per sq. in., any pin holes or cracks are quickly revealed Pin holes are carefully filled with a touch of the welding rod, to prevent leakage of Lionoil into the finished airplane following final assembly Cracks are repaired by grinding, filing, or sawing the weld away and refilling the joint with a solid weld Arc marks have been a source of considerable trouble and there is no cure for this except careful training of welders This occurs when a welder inadvertently touches his rod while "live" to a part of the structure not to be welded A structural member can be weakened in this way, and when this does occur, a repair is sometimes necessary.

Assembly of fuselage structures is greatly speeded through a complete breakdown of the welding operation into the maximum number of sub-operations. This has two distinct advantages It permits the welder to get at his work with the greatest ease and accessibility And it provides a running check on tolerances and warpage. Since most of the welding is done on small subassembly jigs, there are relatively few welds left to perform on the final assembly fixture. This lessens the chance of warping and shrinkage of the completed structure and serves to speed the entire welding assembly procedure

Future Improvement

Welding machines are being further improved and it is believed that this will help speed aircraft work still more At present, the chief control over the weld is the technique of the operator He varies the arc to provide a wider arc and consequently greater heat for welding of heavy tubing, while a shorter arc and lower heat is employed for lighter welding A light, simple and positive amperage control will help to give the electric arc greater flexibility for performing welds under a wider range of heat control This improvement will soon occur

The lower longeron of a trainer fuselage is welded in this massive jig.

Sperry Corp.

(Continued from page 39)

"The corporation is a servicing organization. We approve general policies but all details are left to the separate firms. We merely oil the wheels."

Sperry marine searchlights are used on most steamships as well as in the U. S. Navy.

The Sperry Platform

1. At the root of all Sperry activity is research. Each of the three manufacturing divisions is essentially an engineering organization. Sperry lives on and through its engineering brains. Its reason for being started with research and each step of the way has been due to continued research. In addition to the dramatic new developments produced by Sperry scientists, such as the gyro-pilot, the flightray, anti-aircraft equipment, fire control and hydraulic apparatus, there have been steady but less dramatic improvements in making old products do their job a little faster or a little better. Sperry's task is a never-ending job of scientific exploration.

Research itself is of prime importance in the Sperry platform. But to win a war it is necessary to accelerate research. "Progress will come eventually," said Tom Morgan, "but we can't wait for slow, leisurely developments. Our job is to accelerate research in every way possible. The solutions to critical problems that may help to win the war are just over the horizon. We must reach those solutions as rapidly as is possible."

2. Many possibilities for commercial products emerge from the Sperry laboratories. Those that are put into production have certain qualifications which are indicative of the corporation's thinking. Basically, a product must be hard to make. There are plenty of firms to make the easy products—Sperry wants only the tough ones. Whether or not its products can be patented makes little difference to Sperry. Basic patents on the gyroscope ran out some years ago. Now anyone is free to make such instruments as a gyro-compass—but it's a tough job, as several firms that have tried and failed will tell you.

3. Another plank in the Sperry platform is to have a diversity of products. As mentioned earlier, there are five general fields of activity for which the corporation is now building products: anti-aircraft, confidential equipment, aviation, hydraulics and marine. In two of these fields, come peace or war, the surface is only being scratched at present—aviation and hydraulics. To quote Mr. Morgan:

"Sperry's field of engineering activity has been broadened during the past few years by entry into the field of hydraulics. Hydraulic units complement many of our other products, just as the muscle in your arm serves your brain. Hydraulics is still an infant industry. There are many fields in which the principles of hydraulic transmission of power have not been applied, and there are many new applications for hydraulics in the industries in which it has already been introduced. Hydraulics and aviation, in my opinion, stand today at the forefront as relatively untouched frontiers of American industry."

4. Men are the most important part of an organization. Choose them properly, put them in a job they can do and then give them freedom to do it.

5. The strength of man power is increased many fold through efficient company organization. Tasks assigned workers should be clearly defined, and relationships between one position and all other positions should be definite and explicit. There should be no overlapping, nor any gaps. Company policies should be set forth clearly on such matters as distribution of responsibility, standing rules and operating procedures, wage administration defining skills and characteristics required in each job, and accounting practices that specify distribution of operating expense by responsibility.

6. Anticipate changes and prepare as far ahead as possible to meet them. This is industrial planning in its best sense. Plan in advance your products, your production facilities, your personnel, your methods. It is significant that Sperry anticipated a considerable amount of the present need for its products. Four years ago, as pointed out in the June issue of AVIATION, Sperry management saw that it would need subcontracting firms at some time in the future. As a result, surveys of potential capacity were made, educational orders were given, and gradually subcontractors were taught to work to Sperry specifications. Plans were also made as to facilities in adjacent buildings that could be leased. As a result of this planning, Sperry's expansion has been carried on smoothly and efficiently.

Sperry Gyroscope Co.

The Sperry Gyroscope Co. is the oldest and largest unit in the corporation. It was founded in 1910 by the late Dr. Elmer Sperry, one of America's greatest and versatile scientists. Since that time a considerable line of unique engineering products have been developed and produced by this company. The gyro-compass revolutionized the science of navigation and gun-fire control. As far back as 1913 Sperry organized an aviation department and the following year Lawrence Sperry won the Grand Prix at the Paris Air Meet with an early type of automatic pilot for airplanes. Other new products followed, including a high intensity searchlight developed in 1916 under the direction of P. R. Bassett, now vice president and chief engineer. Other marine products are the course recorder, searchlights, rudder angle indicator, and an electro-mechanical steering system.

Readers of this magazine are more familiar with Sperry's aviation activities than with its other products. Today every large commercial plane, and all military ships except a few primary trainers, carries Sperry instruments. The famous directional gyro and the gyro-horizon are requisites on instrument panels. The automatic pilot is standard equipment on air transports and in bombers. The newer automatic direction finder gives further aid to the pilot flying on instruments. Most recent instrument is the Sperry Flightray, which combines for the pilot the indications of a number of instruments on the face of a single dial.

In the field of anti-aircraft defense, this company has pioneered the development of an entire system against air attack. Sperry sound locators detect the location of an approaching plane, then searchlights automatically illuminate the airplane, and an anti-aircraft director, functioning as a computing mechanism, determines the direction

and elevation and fuse setting required to aim anti-aircraft guns at the plane and to follow the plane across the sky.

Expansion at Sperry Gyroscope has been steady but orderly. In the war years of 1917 and 1918, Sperry production rose from 50 percent of the estimated single-shift capacity of the factory to 120 percent. In January 1939 production was at 150 percent of the single-shift capacity. Now, with the aid of multiple shifts, rented quarters and subcontractors, production is considerably over the 600 percent figure. In two instruments alone, directional-gyros and gyro-horizons, production has increased from 60 a month in 1928 to 600 a month in 1938 and now to 6,000 per month. There are now 8,300 employees working in five different buildings in Brooklyn and Garden City.

The company is soon to break ground for a new factory on Long Island that will have approximately 1,000,000 sq-ft. This will double the amount of floor space available today. With this new unit in production, total Sperry Gyroscope employees will be about 14,000.

Vickers, Inc.

Harry Vickers started his firm in California in 1920 for the construction of specialized hydraulic machinery, including pumps and valves. In 1925 he developed an hydraulic steering gear for automobiles and a high pressure vane pump. In 1930 he moved his business to Detroit, and his entire organization consisted of about a dozen people. By 1937, when the company employed 680 persons, it was purchased by the Sperry Corp. Now Vickers employs some 3,000 people.

The largest producer of oil hydraulic devices, Vickers builds units that handle loads as small as 50 lb and as great as 4,000,000 lb. Light stage equipment in Hollywood, snow removal in Maine, airplanes in the sub-stratosphere, and coal mining machinery far below ground—all may have Vickers hydraulic equipment. The amount of hydraulic equipment in our large bombers is considerable.

Throughout industry, wherever there is a need for a simple and compact unit for the efficient transmission of power at various speeds, hydraulics are finding increased use. The growth of hydraulic equipment in military fields, for elevating guns, for moving gun turrets and for other purposes is steadily growing.

Sperry became interested in hydraulics some years ago and bought the Waterbury Tool Co. in 1935. Waterbury is the pioneer organization in the field and has specialized in building large variable speed transmissions for the Navy. This firm was merged with Vickers and is known as the Waterbury Tool Division of Vickers, Inc. Waterbury builds the large units, and Vickers specializes on the small ones.

The Sperry Corp.'s interest in hydraulics is not surprising. Sperry's automatic pilot for airplanes uses hydraulic means to handle the controls, Ford Instrument's fire control apparatus for the Navy utilizes hydraulics, and other examples could be cited. Thus the tie between hydraulics and the other corporation products is a natural one.

Ford Instrument Co.

All of the output of the Ford Instrument Co. goes to the Navy—and all of it is listed as confidential equipment. Ford specializes in the design and manufacture of computing mechanisms and naval gun fire control apparatus. Beyond that brief statement, little can be said of Ford Instrument products.

Hannibal Ford was one of Dr. Sperry's early engineers, and went aboard the U.S.S. "Delaware" 30 years ago when Dr. Sperry, Ford, Tom Morgan, and R. E. Gillmor met for the first time. Hannibal Ford left the Sperry Co. in 1915 to start his own organization but rejoined the corporation some years later. Thomas B. Doe, vice-president of the Corp. and also vice-president and general manager of Ford Instrument, is now the active head of the organization. Ford Instrument now has some 3,000 employees and has expanded to fill three buildings in Long Island City. Further expansion is definitely in sight.

Sperry, Vickers and Ford are doing a real job in national defense manufacturing today—and doing it exceedingly well. They say little or nothing about their achievements. The facts about their role in defense must be pried out of them.

They are doing a good job because long ago they began to hunt and plan for the answer to Tom Morgan's question: "What is necessary to increase production?"

British Air Power

(Continued from page 31)

protect all its other aeroplanes and to keep the sky clear of enemy aircraft. The RAF undertakes to provide these bombers and fighters as they are required. When the BEF went to France in 1939 it was accompanied by a body known as the Air Component of the Expeditionary Force under an Air Vice-Marshal.

After the BEF had got home from Dunkirk, the relations of the army and the air force were considered afresh, and as a result a new command was instituted in the RAF with the title of Army Cooperation Command. Its main purpose is to ensure that the army staffs and the air staffs of commands, groups, and divisions should have a full understanding of each other's problems, and also to see to it that the RAF shall give the army all the help which it needs from the air. At the head of this new command is an air officer commanding-in-chief.

The air force is prepared to wage war in the air at times when the army is not engaged and in places where the navy cannot penetrate. The bomber command and the fighter command deal with these aspects of air work. The bomber command has to be flexible, ready to attack whatever constitutes the greatest danger to Britain at any one moment. Before the invasion of Norway this war was mainly naval in character, and so the bomber command bombed the German naval bases at Wilhelmshaven and elsewhere, attacked the German fleet whenever it put to sea, and sent "security patrols" by night over the Frisian Islands from which the enemy seaplanes used to start to lay magnetic mines in British waters.

After the BEF had got back from Dunkirk, the bomber command began to wage a campaign on its own account and turned its chief attention to German munition factories and oil supplies, while still keeping up its raids on naval bases and the so-called invasion ports. Neither the navy nor the army can take any share in the destruction which the bomber command has wreaked in the Ruhr district and elsewhere. It is purely an air campaign.

The fighter command hardly needs any explanation. Everybody in Great Britain and the Empire knows how the squadrons of Spitfires and Hurricanes first drove the enemy dive-bombers back from the beaches at Dunkirk, and then defeated the great attempt of the other German bombers to beat this country to its knees by mass raids in daylight last summer. Generally speaking, the fighter command (which has control over the searchlight units and anti-aircraft batteries supplied by the War Office and includes as well the Observer Corps and the Balloon Barrage) is the most static of all our forces, being tied to Great Britain and purely defensive in character. Of late, however, British fighters have been used for aggressive action, escorting bombers in sweeps by daylight over Northern France. It is no secret that fighters with longer range than the Hurricane are being produced, and in the coming months a new chapter in air warfare may very probably be written.

Is there "another woman" in your life?

OF COURSE there is.

She's the one with the pencil and pad who sits by your elbow every now and then. She's the young lady who takes your calls, doles out the aspirin on occasions, and blocks out your would-be tacklers whenever the going gets rough.

Come to think of it, you probably spend as much time in her company as you do with the folks at home!

All of which... if you're the kind of a man we think you are... serves to show what a big, dramatic part of your life your *business* really is. It's Major Item, number one.

So, it isn't at all surprising that the magazine closest to the *news* of *business* is Major Reading, number one, for men of Management.

Far from fancy, that fact has been borne out by nearly every independent study ever made among these men. Consistently, Business Week rates with, or above, magazines of seven, ten, and twenty times its circulation size.

Consistently, too, it holds top rank in still another column.

Advertising-wise, it's entrusted with more pages of advertising directed to Management than any other magazine of any kind!

And in January, the men of advertising increased their investment in these pages by twenty-five percent over the figure for a year ago!

Business Week

Acrobatics Are Easy

(*Continued from page 37*)

avoid pushing the nose away from its original direction. Maintain full left aileron, and enough left rudder to hold the nose in line. As the wings become level, ease all controls to neutral. Simple, isn't it?

The Snap Roll

The snap roll, or "barrel roll," as it was once called, is regarded by some as being easier than the slow roll. This may be true if no effort at precision is made. The writer considers a good snap roll, in which the recovery is made with the wings exactly level and the ship heading the original direction, to be more difficult than the slow roll, and for this reason the maneuver has not been introduced before.

The snap roll is illustrated in Fig. 2. Careful examination of this illustration will show that the maneuver is merely a horizontal power spin, and the control setting is identical with that for a normal spin. Furthermore, if recovery is not made while the ship still has flying speed, a power spin will result. If this should occur while you are practicing, there is no occasion for alarm. Obviously, all that is necessary is to close the throttle—so as to avoid unnecessary abuse of the engine, propeller, and structure—and recover from the spin in the usual manner.

Since the snap roll is one of the so-called "stall" maneuvers, it should be performed at relatively low speed for two reasons. First, since the angle of attack is abruptly increased to the maximum, high stresses are imposed upon the structure if the speed is high. Second, if the speed is too great, the maneuver will be sloppy instead of snappy and a big, loose "barrel-house" roll will be the result. One of the reasons for the name of the maneuver is the very definite snap, or whip, that occurs when it is properly performed. If this snap is lacking, you may know that you have slipped up somewhere in the execution.

The maneuver is performed as follows: adjust the throttle so that the speed is somewhat below cruising, 85-90 m.p.h. is satisfactory in most airplanes. Select some object on the horizon to enable you to check your direction when the maneuver has been completed. Set the stabilizer to a slightly tail-heavy position. (This is not absolutely essential, but helps.) Allow the nose to rise above the horizon to the approximate position of a fairly steep climb. Then abruptly apply full rudder and yank the stick straight back as far as it will go. This is one of the few maneuvers—if not the only one—in which the controls are really manhandled. When you have tried it, you will see why we advised entering it at comparatively low speed.

The nose will rise and swing to the right, (or left, depending on which pedal you booted) and if you have been fast enough and moved the controls far enough, you will feel a distinct whip, which will tend to throw you to one side of the cockpit. If you used right rudder and rolled to the right, you will be thrown to the left, and vice-versa. The ship will roll to the inverted position and continue on around. As the wings become vertical on the way to level flight, return the rudder to neutral if the roll was made to the right. If to the left, it is better to use some opposite rudder in most airplanes. As the position of a 45 deg. bank is reached, return the stick to neutral. The quickness with which the controls are moved during recovery determines where the roll will stop. This should be, of course, at the point where the wings are exactly level, but only practice can tell you just how fast to move the stick and rudder. The roll can be checked more quickly by using full opposite rudder and pushing the stick ahead of neutral. The trouble with this procedure is that too much opposite rudder is likely to change the direction so that you will not be heading for your landmark, and too much forward stick will cause you to recover with your nose down instead of in the normal position. It might be mentioned here that the reason the maneuver is started with the nose slightly up is that the speed drops off during the execution. Loss of speed means loss of lift; loss of lift means loss of altitude. By starting with the nose up, you are more likely to finish with it up enough to offset the loss in speed by increased angle of attack sufficient to compensate.

Most of the errors you are likely to make have already been touched upon, but some will bear repeating. The most common fault is using the controls too gently during the entry. You have been cautioned throughout your flying career about violent and abrupt use of the controls and have probably built up an inhibition against the manner in which they *must* be used to perform this maneuver correctly. You'll just have to swallow that inhibition if you want to get the real snap that indicates proper execution. In addition to your inhibitions, hauling back so quickly on the stick shows by the pressure on the seat of your pants that stresses are being built up and the "g's" are increasing rapidly. This realization also tends to make you ease off, with consequent detriment to successful performance. Don't be afraid to yank the stick if your speed is down to the figure mentioned. Training planes are built to stand just such treatment. On the other hand, don't construe this to mean that you can haul back in a similar manner when you are in a 140-mile dive.

Don't use the ailerons either going in or coming out, but particularly during the entry. They will do no good, and may actually slow down the snap. On the recovery, they will do little harm, but likewise will do little good. Learn to go through the entire maneuver with the ailerons in neutral and you'll have much better results in the end. But be sure that the seat adjustment is such that you can get the rudder all the way over. It is the last inch that does the trick. Likewise, see that the seat cushion or parachute does not interfere with pulling the stick back against the stop.

As previously mentioned, you will probably have trouble in recovering with your wings absolutely level, but the only cure for this is practice. Perfect timing of rudder and elevators is essential for perfect execution, but this is the reason the maneuver is included in advanced training. Otherwise it has no practical value. But it's lots of fun. When you can perform it correctly, you can proceed to a more difficult variation.

The Split "S"

This maneuver is often called the half snap roll, which is a more accurate, but less picturesque, name. It varies from the half slow roll only in that the first half of the maneuver, during which the ship is put on its back, consists of half of a snap roll instead of half of a slow roll. The second portion consists of the second half of a loop in either case.

The split S, illustrated in Fig. 3, is much more difficult than the half slow roll because things must be done in such a hurry. In the half slow roll, you can take your time getting inverted. In the split S, you snap to the inverted position, and by the time you have the roll started you have to begin taking steps to stop it. Furthermore, in the half slow roll, the horizon is always in view. In the half snap roll, it completely disappears during the first part of the roll, leaving you doing a little goesswork as to just what the attitude of the ship is, until mother earth appears once more.

There are two methods of performing the split S. In one, the stick is held hard back until the maneuver is completed, the roll being stopped by use of the rudder alone. In the other, which is preferred by the Navy and the C.A.A., the stick is pushed ahead and held there for a second, the rudder being used at the same time, thus holding the ship

momentarily in true inverted flight. The only difference between the two is in the use of the elevators.

The execution of the split S is as follows: set the stabilizer to a slightly tail-heavy position, throttle back, and bring the speed down to 85-90 m.p.h., just as in the full snap roll. Apply full rudder and yank the stick fully back, also as in the snap roll. If the type first described is to be performed, as soon as the snap is felt, start applying opposite rudder, but hold the stick back. In most ships, full, or nearly full opposite rudder will be needed to check the roll, the speed of application determining how quickly the checking occurs and whether the roll stops when you are exactly inverted, or before, or after. If your timing is correct, the ship will stop rotating when you are exactly in the level, inverted position, and the half-loop will be completed without any sensation of banging on the belt, and your speed will never exceed 90 m.p.h. But you'll have to be fast with that rudder. Otherwise you will go past the inverted position and perform a sloppy maneuver. As soon as the rotation stops—or even a fraction before—get the rudder back to neutral, and don't waste any time about it. You will find that throughout this maneuver your control movements will have to be quicker than in any other. That is one of the reasons it is so valuable for training. A *perfect* split S is one of the most difficult little tricks in your whole course of acrobatics, and chiefly because of the quick reactions required.

The second type is begun just as that described above. However, instead of full opposite rudder when the snap is felt (or when the ship has rolled through about 90 deg.), the rudder should be brought only to neutral, or a little past. When the wings are within about 45 deg. of being level in the inverted position, or, in other words, when the amount of roll is about 135 deg., move the stick slightly ahead of neutral, hold it there a second or two, then bring it straight back as far as it will go.

In both of these types, it is desirable to close the throttle as soon as the ship is inverted, so that the speed will be kept as low as possible during the vertical dive that precedes complete recovery. Needless to say, as soon as level flight is resumed, the stick should be eased ahead to neutral and the throttle returned to the cruising position.

The chief error you are likely to make is being too slow. Until you have tried the maneuver, you will not appreciate how fast you have to be. You will also be glad you have become familiar with unusual attitudes of the airplane and are not disconcerted by them, for relaxation is of great importance. Other errors are leaving opposite rudder on too long, which will change the direction of the nose so that you will not be pointing at 180 deg. to your original direction, and will cause an inverted skid; not leaving opposite rudder on long enough, which will allow you to roll past the inverted position; applying opposite rudder too soon, which will keep you from rolling a full half-revolution; applying opposite rudder too late, which will allow you to roll too far. You may also be careless when doing the second type and not get the stick far enough ahead. This fault will allow you to pick up too much speed in the dive. The same thing will happen if you don't close the throttle quickly enough.

As a final word, you must remember that as in all rolling maneuvers, the ship will rotate more easily to the left than to the right, due to the effect of torque. Such being the case, you will have to begin checking the half roll sooner when you are doing a left roll than when you are rolling to the right. Also, remember the warning we gave you about diving out at high speed. If you get balled up—as you are likely to do on your first few attempts, don't try to pull out. Glide inverted until you have gotten your bearings, then roll out, climb back to a safe altitude, and try again.

The Vertical Reverse

This maneuver is called the "cartwheel" by the Navy, and has also been referred to as the "reversement" or the "renversement." For our purposes, plain "reverse" will do, since it is quite descriptive. However, the "vertical" part of the name is not so descriptive as it once was. The maneuver was formerly performed from a vertical bank, hence the name. Now, the initial bank is about 45 deg. or a little more, and the maneuver consists of part of a snap roll from such a bank to a bank of equal amount in the opposite direction. If by this description we have succeeded in getting you completely confused, let us hasten to put it in somewhat more lucid language. Let's assume that you are making a turn to the right with a bank of about 45 deg. By proper manipulation of the controls, you snap roll the ship into a left bank of 45 deg. and continue by making a turn to the left. Does it sound easy?

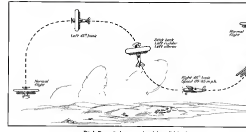


Fig. 4. The vertical reverse, viewed from slightly above

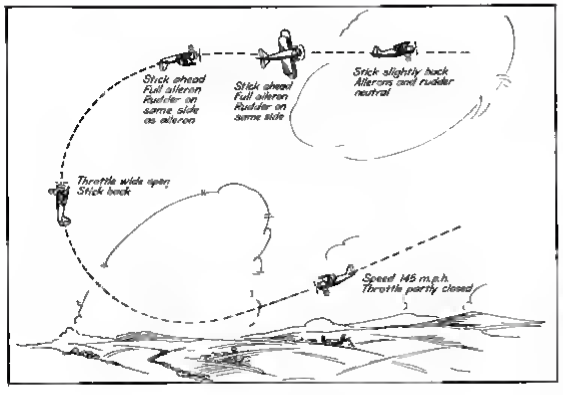


Fig 5 The Immelman

Well it isn't That's why it has been held back until near the end of your course It's not even easy to illustrate pictorially, but we've done our best in Fig 4

There are two ways of executing the maneuvers If you are ready, we'll try the first Put the ship in a right turn with a bank of 45 deg and the throttle set at the cruising position or a little less Tighten the bank until the airspeed drops to about 80 or 85 m p h Then apply plenty of top rudder and pull the stick straight back, the nose will rise, the horizon will disappear, and the ship will flop over into a left bank The trick is to get the stick and rudder back to neutral so that the left bank will also be 45 deg If you are too slow, you will fall off into a beautiful left spin However, if you neutralize the controls just as the left wing starts to drop, you will come out about right, but at somewhat reduced speed This means that you will have to fly through perhaps a full 360 deg before you have speed enough to try it in the opposite direction, for unless the airspeed is showing at least 70 m p h there's little use to try it Even this is mighty low, for so much speed is lost in the quarter roll that you will be only a little above stalling when you get over to the other side When performed in this manner, the maneuver is very hard to control; that is, it's extremely difficult to flop over to exactly the same degree of bank (to the opposite side) as you had originally Hence the second method of execution is preferred.

In this second type, the ship is put into a 45 deg bank as before (Let's assume it's a right bank) The bank is tightened up in the same way, but this time as you apply left rudder, don't use quite so much Pull the stick back, but not quite so far, and—here comes the chief point of difference—apply plenty of left aileron As the nose goes "over the top," neutralize the rudder and let the stick go forward to neutral, at the same time neutralizing the ailerons Then back pressure is again applied to maintain the left turn This stick movement is referred to by some pilots as "sweeping out the cockpit" If you will study the path of the top of the stick you will see that it is in the shape of a flattened circle, or a rectangle with rounded corners

Now neither one of these methods seem to involve any very complicated procedures, do they? Nevertheless, you will find that the most careful timing is necessary if you are to do the maneuver smoothly and perfectly, coming out with just the right amount of bank and with speed enough to permit your repeating the reverse in the opposite direction by the time you have made about 90 deg of the turn. Your chief faults will be first, a tendency to hurry; and second, strange as it may seem at this late date overcontrol Take your time, keep relaxed, and use too little rather than too much control, increasing as it seems necessary Only two things can happen (beyond general inaccuracy, of course) If you don't use enough control, you simply won't flop over If you use too much, or leave it on too long, you'll spin Neither of these eventualities is anything to worry about Lead with the rudder rather than the stick, as this will start the roll and lessen the tendency to stall And you won't need to pull the stick hard back, especially in the second or 'controlled" type You are likely to become very annoyed at this maneuver until you learn it, because it seems so ridiculously easy and yet you have a heck of a time performing it smoothly But keep plugging at it and you'll find eventually that you will wonder why it ever seemed hard

The Immelman

This maneuver, illustrated in Fig 5, was developed during the first World War by the German pilot after whom it was named. It is a combat maneuver, by means of which altitude is gained and direction of flight reversed simultaneously—or practically so In a ship with relatively high horsepower, it presents no difficulties, but in the average training plane, it calls for keen judgment of speed, good timing, and good orientation. In effect, it is simply the reverse of the half slow roll In other words, it is a half loop, followed by a half roll However, the difficulty, in a low-powered ship, lies in the fact that the half roll is done at the top of the loop, when the air speed is lowest and hence the ailerons least effective.

The maneuver is executed as follows dive until considerable excess speed has been attained In trainers of the Waco type, about 145 m p h is desirable In others, such as the Fairchild, even 160 is not too much Before beginning the dive, it is desirable to select some outstanding object on the horizon, directly behind you. A cloud of unusual shape and near the horizon is as good as anything The next best choice is our old familiar straight road, which will serve as a check, though not so much as a guide Ease the throttle back during the dive, so as to keep the r p m within the proper limits

Ease the stick back and the throttle open as in an ordinary loop, except that you should feel appreciably more pressure on the seat of your pants, both because of the increased speed and because the loop should be pulled a little tighter than the normal loop Just before the absolute peak of the loop is reached, or, in other words, when the nose is still somewhat above the horizon, ease the stick forward of neutral, apply full aileron without delay, with a tap of opposite rudder on the same side as the ailerons As the ship rolls into normal flight, ease back on the stick enough to keep the nose slightly up so as to prevent undue loss of altitude or settling Remember that the speed is at this point quite low, and it is necessary to maintain a fairly high angle of attack to compensate for this condition Your nose should be pointing directly at the object you selected on the horizon, or else you should be flying directly parallel to the road, but at 180 deg to your original direction As soon as normal speed has been resumed, ease throttle to cruising

(Turn to page 176)

Stacking Delays

(Continued from page 158)

Recommended procedures are either a 4 min timed turn to the left if holding at 2,000 or 3,000 ft, or a procedure turn started 3 min south of Coney Island if holding at 4,000 ft. The advantage of the latter maneuver if the flight is originally at 4,000 ft is that it allows approximately 8 or 9 min before returning to Coney Island during which clearances should normally be received to 3,000 and 2,000 ft

It is almost axiomatic that no procedures ever work out as successfully in practice as on paper This is true also of those just described The strategic plan of each appears well conceived for the purposes it is designed to accomplish, the tactical execution of these plans, however, leaves something to be desired

While the new Chicago approach and holding procedures represent a real advance over former procedures, they cannot be considered more than partial answer for expediting traffic in instrument weather The advantages offered are due largely to the radical revisions made in holding and approach procedures plus the possibility of straight-in approaches from the southeast by use of the Ashburn marker No attempt has been made to speed up communications procedure by use of a direct communications system as at LaGuardia

Likewise, the maximum theoretical advantages of the new system cannot be realized in practice due to the layout of the range facilities The presence of a 500 ft gas tank 2 miles southeast of the airport and alongside the approach leg has necessitated that the Ashburn marker be placed slightly too close to the field for a normal descent from 1,610 ft This situation practically excludes the possibility of landing directly out of an approach unless a fairly strong northwest wind prevails. In addition, the area of the marker's visual signal is so limited that it is very easily missed if a pilot is even slightly out of position If several flights are planning Ashburn approaches at close intervals a miss of the marker by one flight will usually mean that all flights following it will not be allowed to make an Ashburn approach but must hold their altitude across the range station to Wilson and make their approach from that point Obviously also, when A T C. holds are necessary the Ashburn approach cannot be used since it would be impractical to be making approaches from two directions under the existing system of control The disadvantage of the approach from Wilson is that the intersection itself is located too far from the range station. If it were closer, the time interval between successive approaches could be materially reduced.

After a trial of approximately six months it seems from pilot reports that Range Control operation at LaGuardia is still far from satisfactory While in theory, it appears to offer a logical answer to traffic delay, technical difficulties have radically interfered with its efficiency in practice

One serious source of trouble is the unsatisfactory character of the LaGuardia range itself A pronounced bend in the northeast leg just south of the Port Chester marker has rendered straight-in approaches from this direction sufficiently uncertain as to make the standard procedure preferable The southwest leg is also difficult to follow due to a bend between Coney Island and the range station plus multiple courses and bends south of Coney Island. Experiments, however, indicate that relocation of the range station may improve this situation

Pilot reports also indicate that the experimental system of direct communication has been unsatisfactory in practice. Even with favorable conditions inbound flights are experiencing difficulty in making contact with Range Control at a reasonable distance from the airport It appears that Range Control radio facilities are weak in output of signal as well as uncertain in operation Possibly personnel trouble both on the ground and in flight is partially responsible for some of the difficulty being experienced as numerous reports have been received of deviations from the proscribed procedures The net result is that pilots are tending to be distrustful of the whole system

While most of the troubles being experienced with Range Control seem remediable, delay in doing so may finally result in abandonment of the whole idea. Considering the possibility it offers of as many as 15 landings per hour in instrument weather instead of 5 this would be a serious setback to efficient traffic control.

Acrobatics

(Continued from page 174)

Your most likely error at first will be to reach the peak of the loop without enough speed to do a decent roll, In this case you will wallow over rather than roll Another common fault is rolling too soon, in which case you will come out with your nose 'way up and will probably stall, or rolling too late which brings you out in a dive, and results in nothing more than a poor imitation of half of a Cuban eight Still another error is not using full aileron or not applying it quickly enough When you have decided it is time to start the roll, don't waste any time doing it

A perfect Immelman is one of the showiest and at the same time, for combat work, one of the most valuable maneuvers. Practice it until you can do it perfectly

This is the last of the maneuvers you need to know Once more let us caution you to check your ship, your 'chute, and the tightness of your belt, to maintain a minimum of 3,000 ft, and to take an instructor with you And with this we leave you, knowing that if you have carefully followed the dope we've tried to hand you, you too will say that acrobatics are easy

Window Shopping

Bailey Recorders—Bulletin No. 111 on recorders for pressure and temperature Permanent records of process conditions to improve safety and economy of steam turbines, heat exchangers etc Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland Ohio.

Kollsman Direction Indicator—New instruction chart on Kollsman Direction Indicator also charts on Air Speed Indicator, Sensitive Altimeter, Vertical Speed Indicator, Manifold Pressure Gage, and Centrifugal and Magnetic Tachometers Kollsman Instrument Div of Square D Co., Elmhurst, N Y.

Clark Pictorial—Defense Edition showing various models of Clark Trucks in action Clark Tructractor Div of Clark Equipment Corp., Battle Creek Mich

Painting Time Will Soon Be Here—Catalog of paint supplies All decorating waterproofing painting and roof repair supplies are available for delivery from one organization. Paint Final Products Co Inc. 99 So 6th St., Brooklyn, N Y

The Technique of Noise Analysis—Interesting booklet on instruments for measuring torsional vibrations, exhaust noises, etc. General Radio Co, Cambridge Mass.

Amer[illegible]—Plastic Coatings—Of specific value to technically minded plant superintendents this catalog explains uses for a sprayable corrosion proof and non-contaminating plastic. American Concrete & Steel Pipe Co, Box 3428, Terminal Annex P O, Los Angeles, Calif

Metco Metallizing Equipment—Bulletin No 42 on how to rehabilitate worn shafts and other rotating machinery and protect metal surfaces. Metallizing Engineering Co. Inc., 21-07 41st Ave Long Island City, N Y

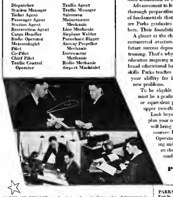
Ex-Cell-O Precision Boring Machine—New series of folders just printed on Ex-Cell-O machines for boring turning, facing etc. Ex-Cell-O Corp., Detroit, Mich.

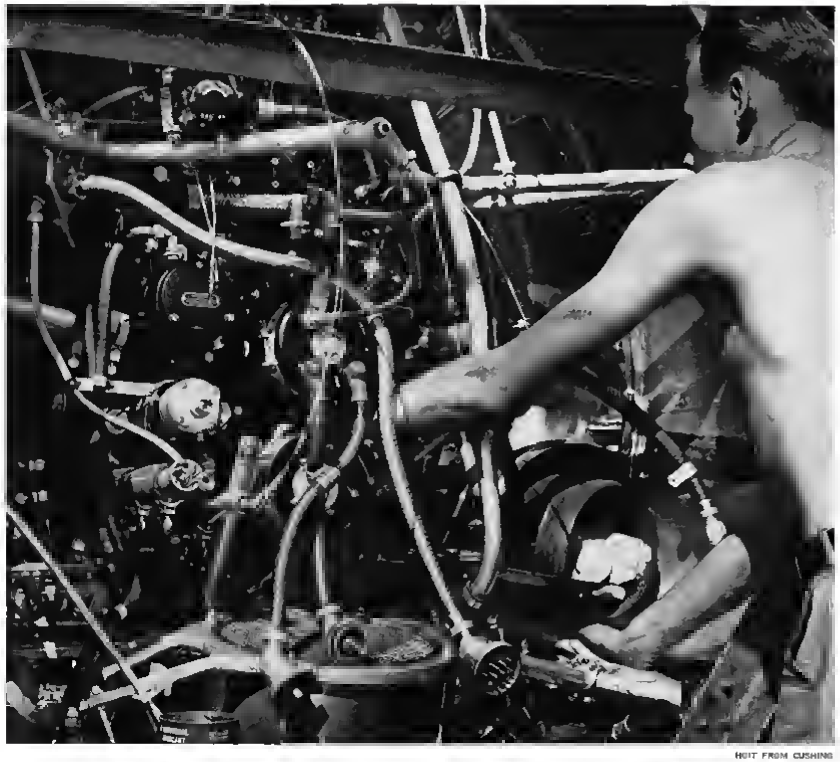
Safety Equipment Catalog—One hundred pages of industrial safety equipment made by a century-old firm Right type of equipment for every type of hazard American Optical Co., Southbridge Mass.

Multiple V-Belt Drive Data—Comprehensive 64-page book covering all types of V belt drive applications containing full information on [illegible] demountable hub sheave, and complete specifications together with list of sizes carried Fort Worth Steel & Machinery Co., Fort Worth Texas

Cardox Fire Extinguishing System—Booklet presenting a solution to the industry's fire problems, said to be safe, sure and clean, and completely automatic Cardox Corp 307 N Michigan Ave Chicago Ill.

The Dragon—A Fafnir publication containing articles of current interest concerning bearings. Fafnir Bearing Co, New Britain, Conn





HOIT FROM CUSHING

Save a Penny and Lose a Life?

. . . that's no Bargain!

★ Of course it isn't. And yet, that's the exact risk you take—to say nothing of the plane and its mission—when you use aircraft magneto contact points of unproved value.

★ But there's another reason why such critical aircraft magneto manufacturers as Bendix-Scintilla specify AERALLOY contact points. The same unfailing precision that has made AERALLOY the choice of the Army, the Navy and every major airline in America, makes AERALLOY the choice of the production line. The refining, the assaying, the skilled tooling—and each of the 18 operations in producing AERALLOY means faster assembly and fewer headaches.

★ You'll prefer AERALLOY—the aircraft magneto contact point that represents so much more than a mere combination of metals to meet a formula. You'll also prefer Wilco Thermometals—the thermostatic bi-metals for reliable temperature control or reaction from temperature change. Both are described in the famous Wilco Blue Book. Your copy is waiting—shall we send it today?

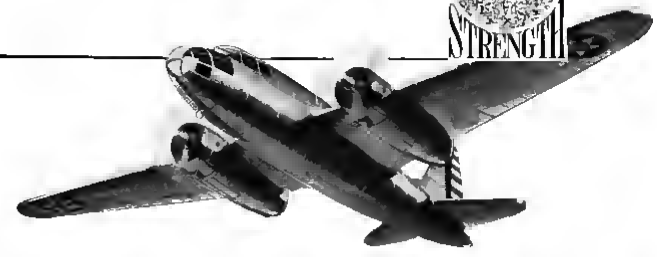
AERALLOY
WILCO

THE H. A. WILSON COMPANY
105 Chestnut St., Newark, N. J.
Branches: Chicago ★ Detroit

There are many applications for this low alloy steel . . .

N-A-X
High Tensile
in Airplane Manufacture . . .

DUCTILITY
ITS INHERENTLY FINER GRAIN MAKES ALL THE DIFFERENCE
STRENGTH



Because it is possible to reduce weight without sacrificing strength, N-A-X HIGH TENSILE is being tested for many important aviation parts and products.

A factor of particular importance to aircraft engineers is the *very high* resistance N-A-X HIGH TENSILE has to impact and fatigue, both at normal as well as at sub-zero temperatures. This means that parts and products fabricated of N-A-X HIGH TENSILE have unusually high resistance to shocks and stresses—will operate at high efficiency in all kinds of weather conditions with lower maintenance and replacement cost.

FABRICATION—N-A-X HIGH TENSILE can be formed readily, either hot or cold, with all the ease and speed of mild carbon steel—it goes through each phase of manufacturing smoothly, easily, quickly and economically. Its superior ductility permits cold drawing into intricate as well as simple shapes. And because of its extremely high ductility, finished products and parts have unusually high resistance to IMPACT and FATIGUE, at very hot or sub-zero temperatures. It possesses excellent welding properties and has good resistance to both corrosion and abrasion.

A Great Lakes engineer will be glad to show you how you can use N-A-X HIGH TENSILE to advantage. Write, wire or telegraph for one today.

LIST OF PRODUCTS

Hot Rolled Strip (down to 1 inch wide) — Hot Rolled Strip Sheets (up to 91 inches wide) — Spring Steel (carbon and alloy) — Merchant Bars — Forging Bars — Automobile Bumper Sections — Bar Mill Sections — N-A-X HIGH TENSILE Bars, Shapes, Sheets, Billets — Sheet Bars — Hot and Cold Rolled Sheets — Michigan Metal for Vitreous Enameling — Deep Drawing Quality (in all grades, widths up to 91 inches) — Stran-Steel Metal Framing for Residential and Commercial Construction.

GREAT LAKES STEEL CORPORATION—DETROIT, MICHIGAN

Sales Offices in Principal Cities

division of NATIONAL STEEL CORPORATION
Executive Offices, Pittsburgh, Pa.

The Fault Finders at Work...

ON the indicator in the Airport entrance-hall the midday Southbound is scheduled to depart at 11-55 ack emma It is now just 10-16 yet the great fifteen-place ship has already been out of its hangar for close on an hour

When the time finally comes chocks are withdrawn and the twin engines roar into exultant crescendo for the take-off a small gang of men in oil-smeared overalls will be watching with approving confident eyes from the shadow of the control tower Those men are the fault-finders, and their job is a vital one Check test and counter-check Everything must be just **right.** The safety and efficiency of the ship is only gained by long hours of unremitting toil

In the VOKES laboratories this same unremitting toil has been directed to the problem of filtration, and today the Vokes technologists have just cause for satisfaction The result of their research has been the introduction of **an entirely different principle** of filtration which gives the amazing percentage of 99 9% efficiency This is as near perfection as it is possible for human endeavour to reach These filters (available for air and for high and low pressure oil systems) filter down to particles 0 00004 in diameter

The value of such absolute filtration cannot be over-estimated Here at last is **pure** air and **pure** oil —bringing inevitably with them greater working efficiency less wear and tear fewer renewals, less trouble We shall be pleased to answer all enquiries through our agents

VOKES

VOKES LIMITED · FILTRATION EXPERTS

American and Canadian Agents E Cantin, 101 Park Av., New York

"It's that man with the CESSNA again"

YES . . . and wherever you may go you will find Cessnas *getting the job done* for their owners Because of their 30-year-old record of satisfactory performance Cessnas have won recognition by Military Authorities and are doing their stint for the Democracies

LET'S GO! U.S.A. KEEP 'EM FLYING!

CESSNA AIRCRAFT COMPANY

CONTRACTORS TO THE U S ARMY AND THE ROYAL CANADIAN AIR FORCE

WICHITA, KANSAS, U.S.A.

The Birdmen's Perch

Last month we announced a new policy—tougher problems. So we started off with a tough one and what happened? The customers not only get the wrong answers—they don't even get our explanation of the correct one! From now on, maybe we ought to call 'em *double-puzzles!*

Major Al Williams, alias "Tottered Wing Tips," Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

FUNNYBONER DEPT.

Dear Major:

The other day I was sitting around the airport waiting for the wind to die down. As my thoughts wandered, I picked up a pencil and pad and set them down. Well major, seeing it sort of fits in with your swell product, I decided to send it along and let you look it over.

Here it is:

I bought an airplane, second hand,
To some it's junk, to me it's grand
Its motor used to spit and sputter
Till I met a man who began to stutter—
Use GGGGG-A GGGGGGGGG!
I filled her tanks and off I went
And passed a Grummen h— bent
Well, mister, you can take it from me,
From now on I'll stick to G A G!

Yours truly,

Wm. (Flying Bill) Ridley, Jr.

THIS MONTH'S BRAIN TWISTER

The following problem is undoubtedly one of the most difficult that has ever appeared on this page. You can blame your head-aches on Lt. Albert S. Ogden, of Upper Darby, Pa. If you get this one, boys and girls, you've *got* something!

A pilot takes off from his home airport and flies directly into the wind. Right after taking off, he sees his air-speed indicator is broken. So he decides to fly with a constant throttle setting and consequently a constant but unknown air speed. Suddenly he finds himself flying into fog. Just as he enters the stuff, he notices a landmark directly under him which he knows to be 40 miles from his home field. He continues to fly (still into the wind of course) into the fog on instruments for one half hour. He then gives up and turning around instantly, heads for home. He flys out of the soup just in time to find himself *directly* over his home field.

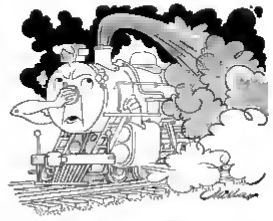
Assuming a constant wind velocity at all times, how fast is the wind blowing?

Lt. Ogden says pat for the above is 20 minutes!—Ed.

ALL ABOARD FOR GULFPRIDE!

If you've ever watched a steam engine puffing down the tracks, you've noticed the thick black smoke that emerges from the stack when the fireman tosses on another shovelful of coal.

Why don't ordinary house chimneys smoke that way, too? It is because of the difference between hard coal and soft coal. Only soft coal is used in steam engines, and it is one of the characteristics of soft coal that it gives off plenty of soot and dirt. Hard coal doesn't.



It's the same with different kinds of crude oil. Some are naturally cleaner. Others are like soft coal—and sometimes it is difficult to get them clean even with the best refining methods.

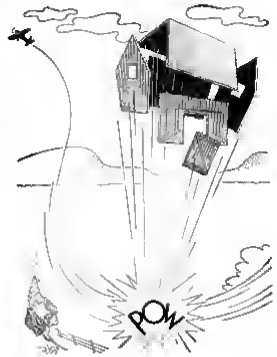
You'll be glad to know that we take no chances with Gulfpride. To make sure it will be the cleanest oil your engine could get, we start out *with only the finest crudes*. But then we refine Gulfpride by means of our Alchlor Process—the special refining method that takes out more of the carbon and sludge makers.

This double trouble we take with Gulfpride assures *you* the finest lubricant with which you could ever protect your airplane engine!

THIS MONTH'S WHOPPER

Dear Major:

A few years ago I had a job barnstorming in Pennsylvania. I had bought an old Jenny from the government scrap pile. My act was to fly through a small barn which had been built especially weak, for the occasion. But I had so little speed that sometimes the barn used to almost fall down on top of me.



One day when I was ready to go up, I discovered that I was out of gas. There was a Gulf tank at the field, so I took an gallon and just for a little extra filled a thermos jug I had along. I got in the Jenny, warmed up the motor and started down the field. About twenty feet before I got to the barn I opened up the throttle. Immediately I felt a blow on my face as I hit the barn. I went through it so fast that the barn didn't fall down till I was 10 miles away. About half an hour later I found myself over the ocean and out of gas.

I crawled out on the wing and poured in the G A G from my thermos jug. When I finally was able to land I discovered that I was in a small town near Paris, France. So here I am—no G A G, no job, no barns, no nothing. All because I put my trust in a small amount of G A G. Major, it's *too* powerful!

Geary Eicher
Pittcairn, Pa.

Low-cost housing for PLANES

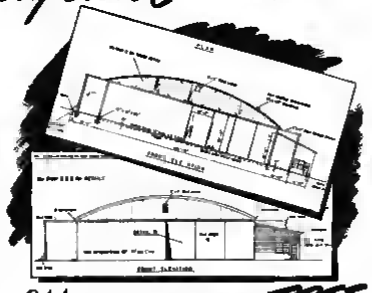
TECO CONNECTOR TIMBER TRUSSES PRODUCE Most economical-Quickly built HANGARS

Lower-cost plane "housing" is yours in timber . . . TECO Timber Connectors permit a smaller quantity of low-cost timber to build stronger, wider span hangar trusses than ever before. The result is a plane shelter quickly produced with economical local labor and materials.

Because they strengthen joints, TECO Connectors permit timbers to do more work. Hangars in wood from 30 to 150-foot span are now available for all types of planes . . . Recent bids demonstrated savings of from 15 to 25% in the first cost of TECO wood-framed hangars.

Working drawings for four standard timber hangars, designs approved by the CIVIL AERONAUTICS AUTHORITY, are available to prospective hangar builders at NO COST.

Plans range from a 47', multiple-section hangar for small planes to a 100'x100' hangar. There are two intermediate sizes—60'x60' and 80'x80'. These drawings are complete and ready for use. They offer an opportunity to secure actual construction costs.



CAA APPROVED PLANS FREE

(ABOVE) Summerhell Roof Structures, Los Angeles, built this 102' span timber hangar for Cal-Aero Corporation, Oxnard, California, and three others like it all within 40 calendar days. . . . Best guaranteed time for erection of these hangars with another material was 90 calendar days.

Other outstanding timber hangar jobs include: (1) 120' clear span hangar Swan Island Airport Portland, Oregon by Timber Structures, Inc., Portland, Oregon. (2) 152 bowstring hangar truss: Wilmington, Delaware by Roof Structures Inc., New York City. (3) 80' glued up laminated arches for 80 x 180 hangar Appleton, Wisconsin, by Unit Structures, Inc., Peshtigo, Wisconsin. (4) 80' clear span truss Deland Florida by J. C. Hartness, Tampa Florida.

TIMBER ENGINEERING COMPANY INC.

Dept. AR7, 1337 Connecticut Avenue

WASHINGTON, D. C.

USE THIS COUPON TO GET YOUR PLANS

TIMBER ENGINEERING COMPANY, Dept. AR7
1337 Connecticut Avenue, Washington, D. C.
Please send me without cost or obligation Civil Aeronautics Authority approved plans for timber-built hangars in the following sizes
47' Multiple Hangar 60' x 60' 80 x 80 100' x 100
Individual
Firm
Street
City State

The Pilot's "Right Arm"!

DELCO

Explosion-Resistant Engine Pump Motor

The fast fighter and pursuit planes of today no longer depend on the pilot's right arm for fuel pressure for starting and emergencies. Manual operation has been replaced by pumps driven by lightweight, dependable electric motors . . . a mechanical source that conserves the pilot's strength and releases his attention for other matters.

Already coming off the line in volume production, Delco engine pump motors and other Delco explosion-resistant motors for aircraft fuel pump applications conform to the latest military aircraft requirements. They are lightweight, compact, dependable.

Delco Products' engineering, research and manufacturing facilities are "on call" to give manufacturers every assistance in the solution of electric motor problems for aircraft applications.

DELCO MOTORS

DIVISION OF GENERAL MOTORS CORPORATION

DELCO PRODUCTS DAYTON, OHIO

Checking the hole layout of a pulley bracket for the rudder and aileron of a Northrop N-3PB

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Bird

KINNER BIRD—Good condition $800.00 M Q Swager, Becker Aircraft Supply Co., Bettis Airport, R D Homestead Penna

Cub

1938 J-3 CUB Sport, Continental A-40-5 Relicensed March first Write for details $575.00 R A Lehman, c/o The Container Co Van Wert Ohio

Fleet

KINNER FLEET—Being entirely rebuilt Bargain $1200.00 M Q Swager Becker Aircraft Supply Co., Bettis Airport R D Homestead Penna

Funk

FUNK 70, New Aug '39 300 hours, excellent maintenance, licensed until Sept, many extras price $850 Must sell J G Boice 100 South Elmwood St Peoria, Ill

Monocoupe

Lambert MONOCOUPE 1935 ship and engine completely overhauled Starter, generator, lights, radio, etc My personal ship Colonel Brown, 311 No 11th St. Louis Mo

Porterfield

PORTERFIELD (35-70) 1936—Just relicensed, new paint, prop, pyralin Red black trim Like new Ring & Compass, investigate $600.00 Roy D Brown, Dimitz Kansas.

PORT 35-70 Fast, economical, privately owned cash or trade Bernard Melinoski Woodbridge St. South Hadley, Mass. (T)

Robin

CHALLENGER ROBIN Starter lights instruments Relicensed to April 1942 Bob Wight, Box 447, Alexandria Louisiana

ROBIN OX-5 304 total hours, new prop, covering excellent, steerable tailskid ship completely gone over, dual controls $295.00 Gene Walden Readfield Wisc

Sikorsky

SIKORSKY S-38 Amphibian This 5 Place Ship with its Wasp Jr P&W 330 H P motor can be a real money maker this summer Ship has all instruments, R C A Receiver Thermocouple, Waltham Clock Large Wheels. Motor has had only 42 hours since complete factory overhaul Licensed to April 30 1942 Total time only 450 hours including 50 hours warm up Will trade What have you, or $5 000.00 cash James R Mock 356 Lake Park Drive, Birmingham Michigan (T)

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AVIATION "Classified" — July, 1941

Undisplayed ads offering only ONE make of plane are grouped under that make. Others appear under "USED PLANES—General" and are numbered and indexed to enable reader to conveniently locate the make of planes offered, or other items of interest. All other undisplayed and displayed ads—excepting those relating to employment and business opportunities—are numbered, or referred to by number and indexed for the reader's convenience in quickly finding ads.

Standard

STANDARD J-5—Late Ben Jones Model 5 POLB—Low hours—good condition being relicensed $2500.00 M Q Swager, Becker Aircraft Supply Co., Bettis Airport R D Homestead Penna

Stinson

STINSON SM8A—Newly recovered and completely overhauled—no time since overhaul and just relicensed—must be seen to be appreciated $1200.00 M Q Swager Becker Aircraft Supply Co., Bettis Airport, R D Homestead, Penna

STINSON 105, 1940 80 horse-power, 75 hours—clean in every respect—just relicensed—one owner—finest Lear transmitter, receiver and loop direction finder Must sell $2200 As good as a new Stinson at half the price Quick sale—cash—first come first served N Bradley Higbie, Jr 244 Buhl Building Detroit Michigan

Stinson

STINSON SM 2AA 4 place, 175 HP majored, just licensed, very economical performer Sacrifice $595.00 cash Frank Arndt 3356 Goldengate, Rock River, Ohio

Taylorcraft

TAYLORCRAFT 1938 A-40-4 Excellent condition always hangared and privately owned Compass bank and turn indicator brakes and tailwheel New pyralin, cables and propeller $895 M Keller 63 Central Park Avenue, Yonkers, New York.

Waco

WACO F Warner Scarab good condition overhauled and wings recovered recently Good bargain $1500.00. M Q Swager Becker Aircraft Supply Co Bettis Airport, R D Homestead Penna.

Welch

1 WELCH OW5M just majored Motor Licensed May 1 1941 One year old Reason—dissolving partnership Howard Hipkins Boothwyn, Pa Box 137

Engines & Parts

See also ads marked (P) in group Classifications

AMERICAN CIRRUS and Wright Gypsy Parts! Complete Stock of Brand New Cirrus and Gypsy Parts at 50% Discount. Write Mensara Manufacturing Company, 6917 McKinley Avenue, Los Angeles, California No 1

LYCOMING 50 H.P. Single ignition We have four just majored New type crank shafts and connection rods Run in ready to go Average time 500 hours Sell separate Attractive price for the lot Embry Riddle Company, Box 668 Miami Florida No 2

Equipment & Products

Aircraft Batteries

AIRCRAFT BATTERIES rebuilt. New plates and separators. Your case, cover and costs Let us quote. Bowers Battery Mfg Co., Inc., Reading Pa No 3

Camera

AERO CAMERA Folmer, Model A-2, 4/5 hand held Immediate delivery Lenge Aircraft Lorain Ohio. No 3a

Cylinder Baking Oven

CYLINDER BAKING OVEN Low cost Automatic time clock. Low wattage Electrically operated Complete $32.98 Aeronautical Trading Co., Floyd Bennet Airport Brooklyn N Y No 4

Instruments

DIRECTIONAL GYROS, Gyro Horizons, Turn and Banks Rate of Climbs Compasses, Auto Compasses Airspeeds, Altimeters, Tachometers, Pressure Gauges Radios, etc. New and reconditioned U S approved instrument repairing Fastest service lowest prices. Free estimates. Write for details Aircraft Instrument Service Inc Detroit City Airport, Detroit Michigan No 5

Equipment & Products

Miscellaneous

SCHOOL EQUIPMENT Hydromatic constant speed Curtiss electric propellers motors mounts wings damaged instruments Pesco fuel pumps motors 27EE central valves suction relief valves List now ready Marvin Northrop Aeroplane Co., Minneapolis Minn No 5a

WACO Advanced Trainer operators attention! 850x10 perfect casings 4 ply $7.50 $9.50 sent approval Tail wheels $10.00 $10.50 streamline $5 perfect. 2000 other tires in stock tubes also Have your spares on hand Marvin Northrop Aeroplane Co. Minneapolis, Minn No 5b

Parachutes

PARACHUTES bought sold serviced and rented New York Distributor for Irvin Air Chute Have several used Irvin Quick Connectors at reasonable prices. Joe Crane Roosevelt Field Mineola L I, N Y No 6

Tires

NEW TIRES: 800x4 and 700x4, $10.00 500x4 and 600x4 $8.00 New fresh stock not rebuilt Guaranteed against defects. Becker Aircraft Supply Co Bettis Airport, Homestead, Pa No 6a

Services & Instruction

Books

PRIVATE EXAMINATION (simulated) 150 Multiple choice questions answer key $1.00 By Flight-Ground Instructor Question Air System, 208 East 34th, Austin Texas. No 7

COMMERCIAL EXAMINATION (simulated) 304 Multiple written questions answers $1.50 By Flight Ground Instructor Question Air System 208 East 34th Austin Texas No 8

AIRPLANE AND ENGINE Mechanics (simulated) over 150 written questions, answers. No C.A.R. diagrams $1.00. Question-Air System, 208 East 34th Austin Texas No 9

EMPLOYMENT

Positions Vacant

WANTED Young aeronautical and mechanical engineer with experience in propeller design Manufacturer supplying U.S. Government Excellent opportunity In reply state education, experience and age P 473 Aviation 520 N Michigan Ave. Chicago 11

Positions Wanted

COLLEGE GRADUATE, Christian, married engaged in investment banking desires to associate himself with air transport company manufacturer, experimenter or distributor PW 677 Aviation, 330 W 42nd St, New York N Y

AS SPECIFIED by the busy executive an assistant capable of withstanding all the pressure you can apply Prepared to accept responsibilities opportunities and an enticing salary PW 67E Aviation 330 W 42nd St. New York, N Y

WANTED

FAIRCHILD "71" seaplane including land under carriage, Wasp "C" or "SC" powered Give lowest cash price and complete information including for aircraft, engine and floats their general condition, manufacture dates hours since new and since overhaul, also float type W 67d, Aviation, 330 West 42nd St New York N Y

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Caldwell-Wright Airport, Caldwell, N. J.
Caldwell 6-1560

R. S. HART AIR SERVICE
New Haven Municipal Airport
New Haven, Conn.
New Haven 4-1829

GEORGE C. HAVEN
Schenectady County Airport
Schenectady, N. Y.
Schenectady 4-1492

GEORGE SCHAAF
Donovan-Hughes Airport
Staten Island, N. Y.
Honeywood 6-1287

STANDARD AVIATION, Inc.
Bendix Airport, Bendix, N. J.
Hasbrouck Heights 8-0202

EDWARDS FLYING SERVICE
Flushing Airport, Flushing, L. I., N. Y.
Independence 3-4843

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Seaboard Aircraft Sales
H. Warren Holladay, Manager
Hangar E—Roosevelt Field
MINEOLA, N. Y.—Phone Garden City 2522

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in New England, New York and all eastern seaboard states

Demonstrator on the field
30 day deliveries at present
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Hangar 'D' Roosevelt Field, Mineola, L. I., N. Y. — Garden City 8753

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(Continued on opposite page)

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LOOK at the multitude of instruments in today's planes. THINK of the tremendous number of planes now being built at top speed for our huge, permanent air force and for our vast expansion airlines. No wonder instrument technicians are in URGENT demand by aircraft plants, instrument manufacturers, and airlines. No wonder there are hundreds of Civil Service openings in instrument work at the huge Army and Navy aircraft maintenance depots—good paying jobs that this school's graduates are getting because their 6 months training serves as COMPLETE substitution for the 2 years actual experience usually required. ALL divisions of Aviation are calling for more trained men than this oldest and largest instrument school can supply for months ahead. Most complete training, including [illegible] Sperry gyroscopic instruments, including automatic pilot. For full details on this fascinating lifetime career, send coupon NOW.

AMERICAN SCHOOL OF AIRCRAFT INSTRUMENTS
DEPT. A-7 — 2002 SAN FERNANDO RD., GLENDALE (Los Angeles), Calif.

Please send catalog describing your catalog and opportunities for instrument technicians.

Name ______ Age ______
Address ______
City ______ State ______

GO UP YOUNG MAN!

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Address ______ City ______ State ______ A 7

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Prepare at home quickly for positions now in big demand. Unlimited future. Training is up to the minute and endorsed by the industry. Write immediately for free booklet.

WESTWOOD School of Aeronautics
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AMERICA'S first line of defense is an invincible air force. "Let's Keep 'Em Flying" by training the needed thousands of new *licensed* Aircraft Mechanics and skilled Production Mechanics. Help yourself by helping the Nation. Fill a vital aircraft defense job where employment is certain and pay is good. Luscombe Training qualifies you for the better jobs in America's Defense Production Army.

Luscombe School is a division of the Luscombe Airplane Corporation, largest manufacturers of all-metal light airplanes.

Free Placement Service.

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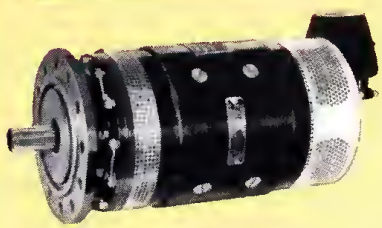

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